SDMS DocID 460323

Harvard Project Services LLC

Via U.S. Mail

June 8, 2007

Superfund Records Center
SITE: Wells G&H 001
BREAK: 8.3
OTHER: 460323

Joseph F. LeMay, P.E.
Remedial Project Manager
US EPA – Region I
1 Congress Street, Suite 1100 (HBO)
Boston, MA 02114-2023

Re: Revised O&M Plan
UniFirst Corporation
Wells G&H Site, Woburn, MA

Dear Mr. LeMay:

Enclosed is a revised Operation and Maintenance Plan for the UniFirst treatment system in Woburn. This final revision reflects the changes that resulted from the replacement of the steel carbon vessels with the fiberglass vessels, as approved by EPA on February 9, 2007. The changes were limited to plumbing changes (valves and pipe layout, mostly). There were no changes in the operational procedures for any of the equipment, in the types of information being monitored by the data logger, or in any other operational aspect of the treatment system.

Should you have any questions, please call.

Sincerely,

T Cosgrave

Timothy M. Cosgrave
Project Manager

TMC:hs
enclosure

cc: Jennifer McWeeney, BWSC, DEP
David Sullivan, TRC
Stephen Aquilino, UniFirst

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Operation & Maintenance Plan

UniFirst Treatment System

Wells G & H Site
Woburn, Massachusetts

Revision #4
June 2007

Prepared for:
UniFirst Corporation

Submitted to:
US EPA, Region I

Prepared by:
Harvard Project Services LLC
The Johnson Company

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1 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to provide detailed information regarding the operation and maintenance, as well as monitoring, sampling, analysis, and reporting for the remedial action at the UniFirst site in Woburn, Massachusetts. The site is located at 15 Olympia Avenue in Woburn, where an on-going business; Extra Space Storage, operates. This plan covers the pumping of groundwater from well UC-22 through an on-site treatment system and gravity discharge to a City of Woburn storm sewer, with an ultimate outlet to the Aberjona River. Also included in this Plan is the sampling and analysis of the influent and discharge from the treatment system, and intermediate treatment process locations, and area monitoring wells. This Plan is written, and should be implemented, in conjunction with the Quality Assurance/Quality Control Plan and the Health and Safety Plan for this site, both of which are available as separate documents. This plan supersedes all previous versions of this document.

1.2 OPERATIONS HISTORY

The system treats volatile organic compounds in ground water from well UC-22, located in the northeast corner of the UniFirst property. The original treatment system, which was designed and installed in 1992, consisted of a multi-media filter to remove suspended solids, an ultra-violet/chemical oxidation (UV) unit for destruction of volatile organic compounds and two granular activated carbon tanks in series for polishing prior to discharge of the treated water to the Aberjona River.

The original treatment system was designed to operate at up to 50 gallons per minute to maintain a water level elevation in UC22 of 15 feet NGVD or less. For design purposes, the influent concentration of organic compounds was 10,000 parts per billion. The UV unit was designed with six lamps to properly treat the potential influent concentrations. Routine sampling of the influent water (Port S1) over the last 10 years indicates that the organic chemical concentrations that require treatment are substantially lower than the design parameters and only three UV lamps were been needed at any time. The maximum concentration of tetrachloroethene measured at S1 was 2,900 μg/L (January 13, 1993). Since March 1, 1995, the tetrachloroethene concentration at S1 has not exceeded 2,300 μg/L, or roughly one-half of the design concentration. Average influent concentrations at S1 for the last two years have been less than 500 μg/L.

After evaluating the historical influent concentrations, UniFirst determined that the UV was not the most cost effective or reliable treatment technology and in 2003 installed a new system that would use only carbon for chemical treatment of the groundwater.

With system startup in 1992, a detailed operations and maintenance (O&M) plan was prepared. The O&M plan was revised in March 1994 to reflect operational experience and minor changes to the system. Water treatment is accomplished through a multi-media filter and three granular activated carbon vessels operating in series. The system has been designed so that three carbon vessels can be operated in any order at any time and the fourth vessel can be serviced.

This version of the O&M plan incorporates all revisions made to the groundwater-monitoring program. The changes to the long-term monitoring program were reviewed and approved by EPA in 1996. No other changes to the long-term monitoring program have been made in this revision.

1.3 GENERAL DESCRIPTION OF FACILITIES

The Treatment system at the UniFirst Plant is designed to treat ground water contaminated with volatile organic compounds pumped from the extraction well UC 22. The treatment system is comprised of a multi-media filter to remove suspended solids, and granular activated carbon tanks to treat volatile organic compounds (VOC). Treated water is discharged to the Aberjona River. A site plan and a schematic of the interior piping are given in Figures 1-1 and 1-2, respectively. A list of the detailed design drawings of the system, and a copy of the Process and Control Diagram are provided in Appendix A. Upon completion of the changes, as-built drawings will replace the design drawings. The system is highly automated with digital flow and pressure sensors that allow for relatively infrequent inspections on a periodic basis and not requiring continuous Operator attendance. The system is designed to monitor its own operating conditions and notify the Operator of any upset conditions that occur between inspection visits. The automated control system allows for remote inquiry by the Operator to obtain a current read-out of operating parameters without physically visiting the site.

1.4 PROJECT ORGANIZATION

Figure 1-3 indicates the organization of the project, and the general relationships between the Owner, the Project Coordinator, and the various contractors associated with the long term operation, maintenance, sampling, and analysis for this groundwater monitoring, extraction and treatment system. The primary contractor that will directly use this Operation and Maintenance Plan is the long-term system operator (the Operator). Primary contacts, and their associated titles, for each company indicated in Figure 1-3 are listed as follows. These contacts are current as of the date of this Plan.

Company/Function	Contact/Title	Telephone
UniFirst Corporation, *Owner*	Brian Keegan	978-658-8888
Harvard Project Services LLC, *System Operator*	Tim Cosgrave, Project Manager	978-772-1105 800-391-3036 Pager

The Johnson Company, Inc., *Original Design Engineer & Hydrogeological Consultant*	Joel Behrsing, Design Engineer Jim Bowes, Control System Specialist Michael Moore, Hydrogeologist	802-229-4600
Project Control Companies, *Project Coordinator*	Jeff Lawson, Project Coordinator	603-966-1600
Environmental Chemistry Consultants, Inc., *QA Officer*	Bruce Wallin, Chemist	207-892-0002
Katahdin Analytical Laboratory	Andrea Colby	207-874-2400
Buckley Brothers Plumbing	Paul Buckley, Plumber	781-322-7509
Heffler Brothers Electrical	Kevin Heffler	781-273-5933

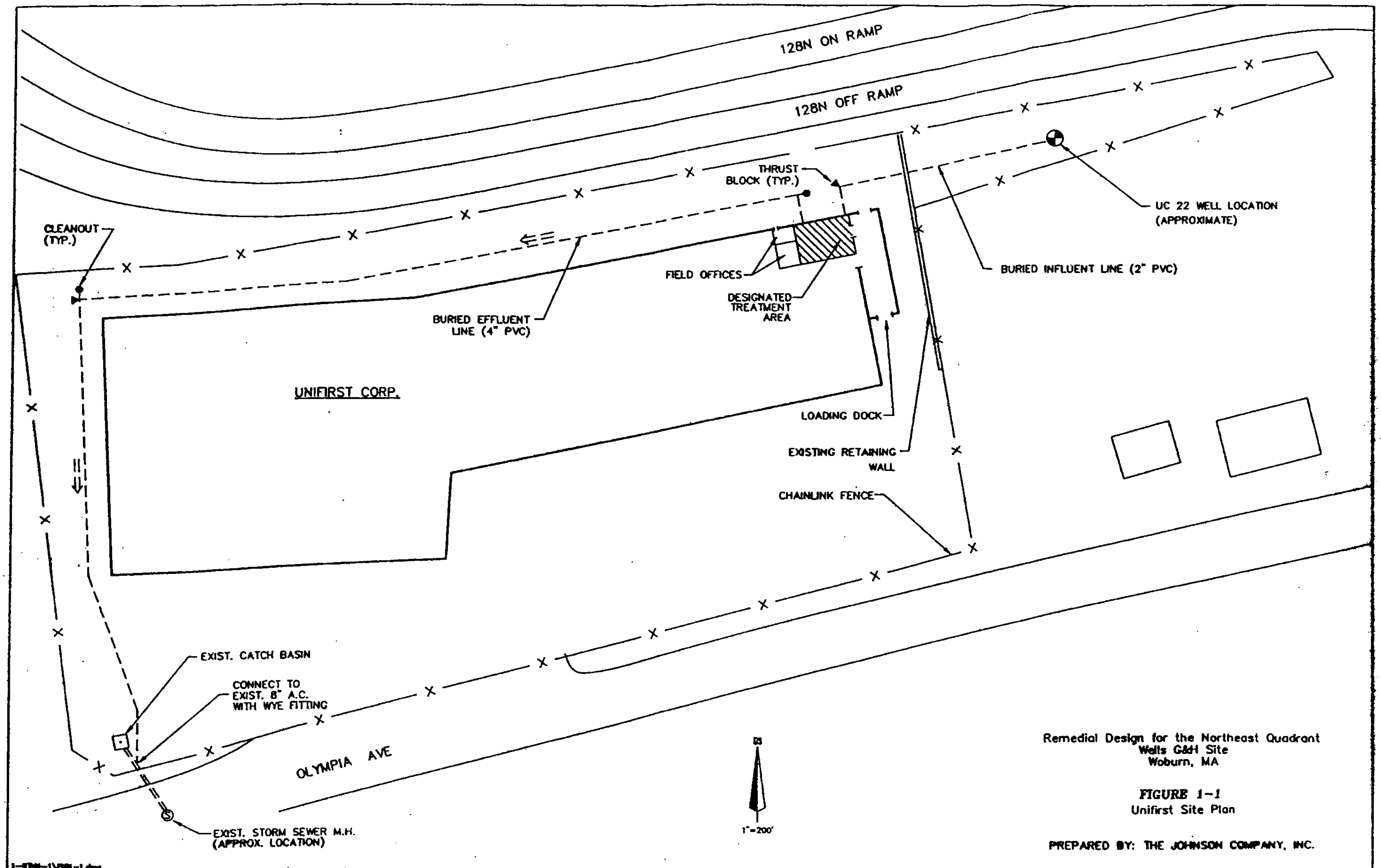
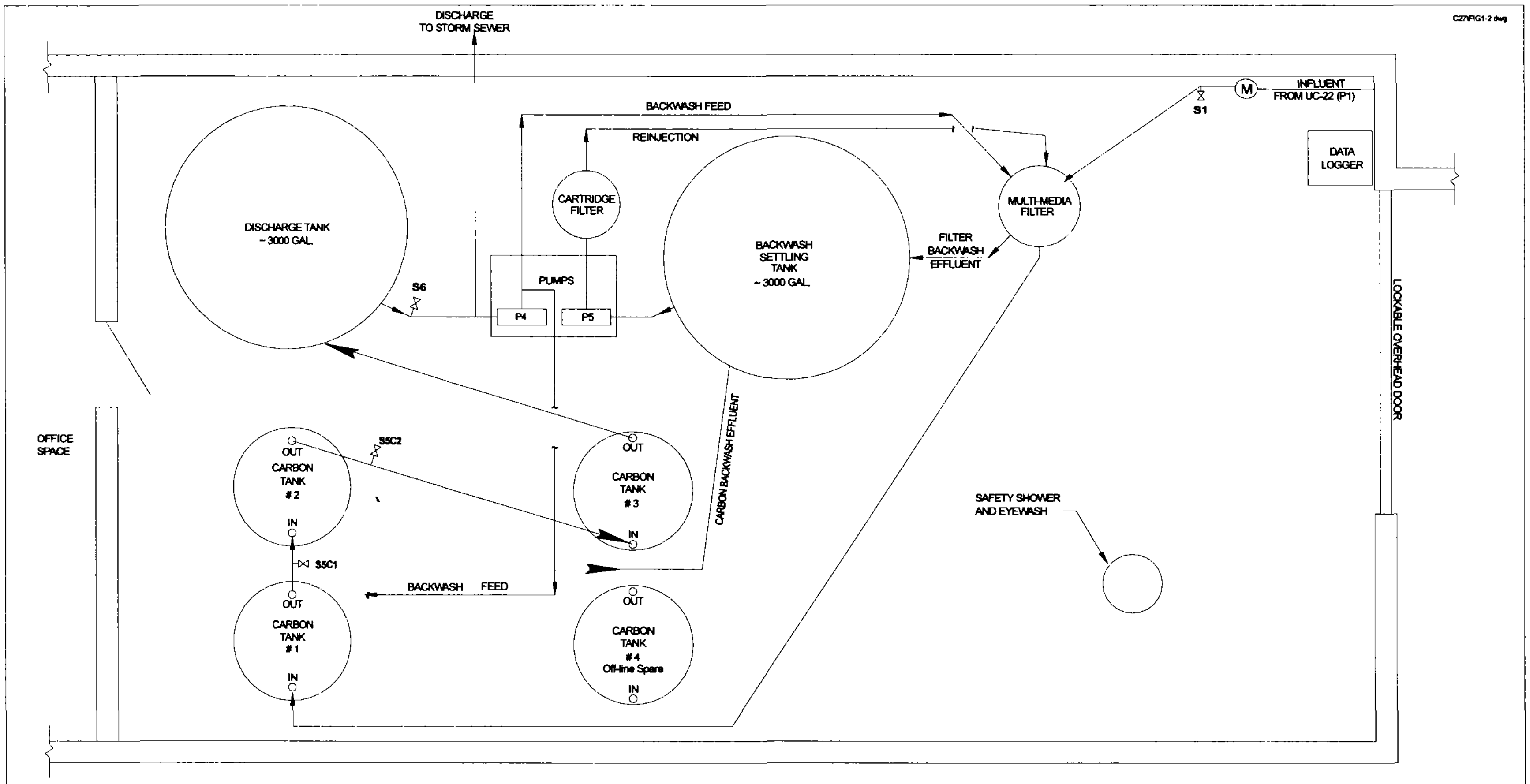


FIGURE 1-1
Unifirst Site Plan

PREPARED BY: THE JOHNSON COMPANY, INC.



LEGEND

S5 SAMPLING PORT

M FLOW METER

Revised: 09/09/02 TMC
Revised: 3/17/94 TJK
Revised: 12/14/92 TJK
Drawn: 9/10/92 TJK

UniFirst Treatment System
Wells G&H Site
Woburn, MA

FIGURE 1-2
Unifirst Treatment System Schematic

PREPARED BY: Harvard Project Services LLC
Prime Engineering
The Johnson Company

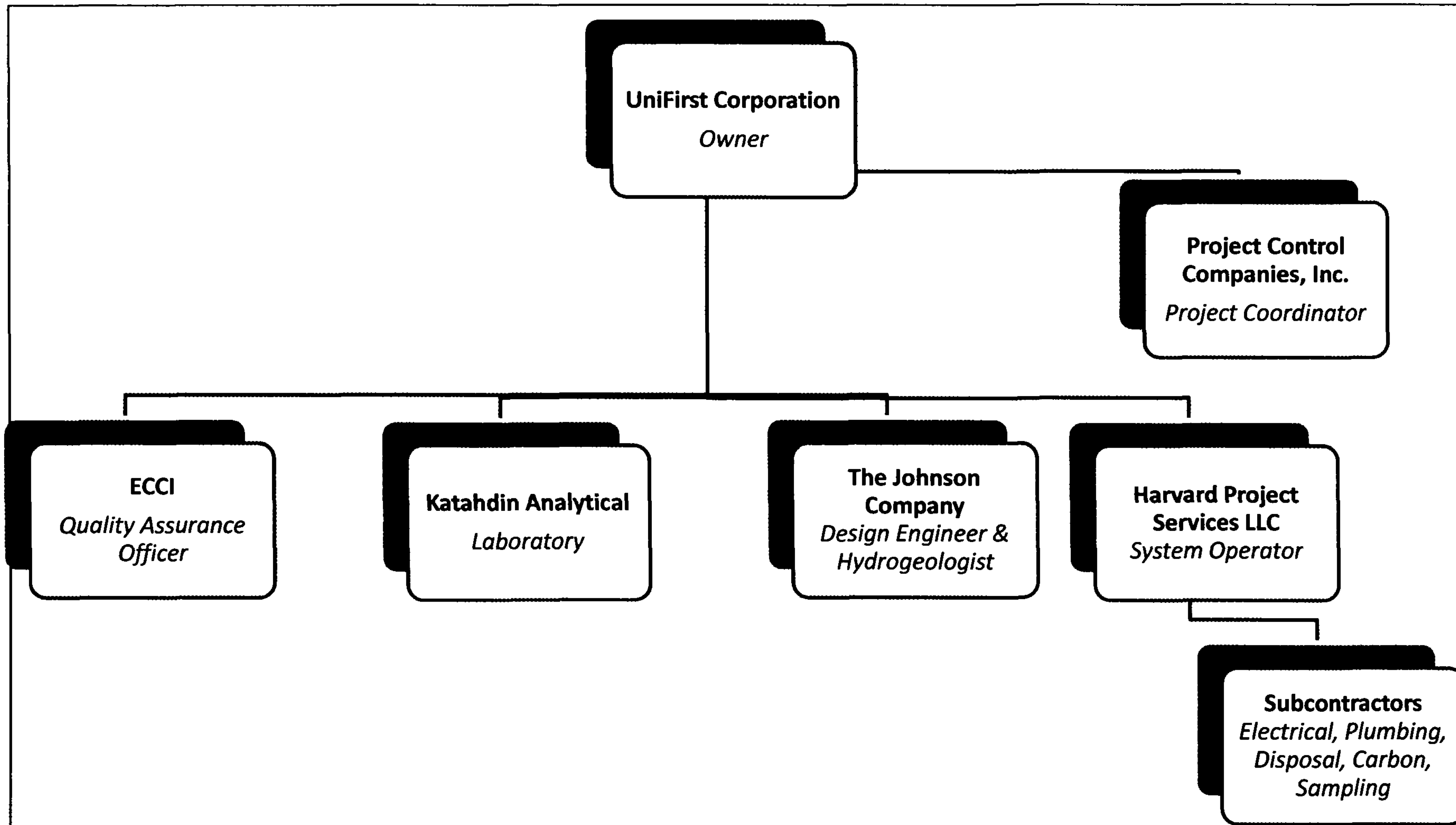


Figure 1-3
Project Organization
UniFirst Treatment System
Woburn, Massachusetts

2 DESCRIPTION OF SYSTEM COMPONENTS

2.1 WELL PUMP

The water is pumped from well UC 22, which is located approximately 150 feet east of the UniFirst building. The well is cased to a depth of about 12 feet with 8-inch steel well casing and has a total depth of 188 feet. The pump is suspended on 2-inch diameter plastic pipe to a depth of 178 feet. The pipe exits the well casing at a depth of approximately four feet below ground surface through a pitless adapter to the buried 2-inch PVC influent pipe.

The current well pump has a 5 hp, three-phase motor, and is manufactured by Grundfos (Model No. 40S30-9). A new pump was installed in July 2004.

2.2 INFLUENT LINE

The 2-inch PVC SDR21 influent line is buried at a nominal depth of four feet below ground surface. In the same trench, there are three conduits for conveying electrical lines and housing the sensor cable. One of the conduits is a 2-inch conduit for the electrical lines to the pump motor. The other two conduits are 1.5-inch conduit: one for the sensor cable and the other held in reserve for future use.

The influent pipe enters the building under the footing of the frost wall and up through the floor slab in the treatment room. A diaphragm check valve at the system inlet eliminates pressure surges through the system from pump start-up. Beyond this point, the flow passes through a digital flow sensor that is connected to a data logger (See Section 2.7: Control Functions) and an electrically actuated ball valve used to adjust the flow from the pump to maintain the drawdown of the pumping well.

2.3 MULTI MEDIA FILTER

The first level of treatment the system flow will pass through is a multimedia filter. This filter is manufactured by Bruner Corporation (Model No. ML300). The operating pressures for this filter are:

Influent Pressure:	40-100 psi
Discharge Pressure:	44 psi
Maximum Pressure Differential	18 psi

Backwashing is required when the pressure differential across the multi-media filter exceeds 18 psi. Pressure in the multi-media filter is monitored with pressure gauges on the inlet and outlet. Additionally, a pressure transducer, located at the same position as sampling port S1, is connected to the datalogger to track the influent pressure at the multi-media filter. The filter may need to be backwashed prior to reaching the maximum differential to maintain flow (see Section 3.4.1: Multi-media Filter).

2.4 CARBON TANKS

The effluent from the multi-media filter flows through three granular activated carbon tanks in series. The adsorption life span of each carbon tank is dependent on the concentration in the influent water.

There are a total of four carbon tanks. In 2007, four new fiberglass tanks were installed at the facility. Each tank has the capacity to hold approximately 1,500 pounds of carbon, but generally hold 1,000 pounds of carbon to optimize flow and backwash operations. These tanks have an inlet and air vent on the top of the tank and an outlet on the bottom. The tanks have a 20-inch bolted cover on the top for access. All tanks have valves at the bottom. Process flow through all tanks is downward. The tanks are designed to be backwashed by reversing flow.

The carbon tanks are connected with a system of 2-inch flexible hoses. There are two manifolds which to connect the tanks to system influent/effluent and backwash influent/effluent flows, as needed. The tanks operate in series by connecting the flexible hoses in the appropriate positions.

2.5 DISCHARGE COLLECTION TANK

The discharge collection tank is a 3,000-gallon high-density polyethylene (HDPE) tank that receives effluent from the carbon tanks. The effluent piping is arranged so that approximately 1,000 gallons will be retained in the tank at all times to provide some equalization prior to the effluent sampling point, and to provide a volume of clean water for back washing the multi-media filter, or the carbon tanks, as necessary.

2.6 DISCHARGE LINE

The gravity discharge line exits the building through the treatment room floor slab, and under the concrete footing.

The discharge line is a buried 4-inch PVC SDR35 pipe that runs along the North and West sides of the building where it connects to a storm sewer immediately downstream of a catch basin on the UniFirst property near Olympia Avenue (see Figure 1-1).

Clean outs are installed at the bends in the line immediately outside the building and at the northwest corner of the building, and are set flush with the existing pavement. The riser is accessed through the threaded caps on the top of the clean-outs and is protected with a cast iron valve box top section. These clean-outs are provided for cleaning the discharge line if needed. It is not anticipated that this will be required very often, if at all.

2.7 CONTROL FUNCTIONS

Automatic monitoring of the treatment system is facilitated using a data logger and various sensors and control valves. The data logger, which is the central control unit for the system, is a Model CR10 manufactured by Campbell Scientific, Inc., Logan Utah and consists of a programmable module which has been programmed to provide sensor measurements, timekeeping, communication, data reduction, data storage, and control functions. Control functions consist of both routine operational and alarm activated functions as described below. These functions are summarized in Table 2-1. An overview of the monitoring and control system is given in Appendix B along with a copy of the program instructions.

The alarm activated control functions consist of two modes: 1) "critical alarm" detection, which if indicated, drops power to the well pump in UC22 (Pump P1) and results in a system shutdown; and 2) "non-critical" alarm detections, which if indicated initiates a telephone call to the operator's pager, but does not result in a system shutdown. The CR10 is programmed with an alarm detection capability of one-minute resolution.

The control functions of the data logger are triggered by either measurement data recorded by the data logger, or by a switch monitoring system routed through the data logger. Various components of the UniFirst treatment system are monitored by connecting the data logger to a Model 910 Annunciator (McMaster Carr). The 910 Annunciator contains a central relay panel composed of 10 independent switches. Relays and/or contacts from the individual alarm modes are connected to the main circuit of the 910 Annunciator. The annunciator is used to monitor components considered critical functions.

The annunciator provides a link between on-site conditions and the data logger. The link is provided by a direct wire connection from the data logger control port channels (channels 4 and 5) and a relay switch from the main circuit board of the annunciator. If an alarm is indicated from any of the external relays or contacts connected to the annunciator, the data logger will acknowledge, and respond accordingly. Additional details on data collection and control and alarm functions are provided in Appendix B.

2.7.1 Routine Control Functions

Automatic Valve Operation: The primary routine control function of the data logger consists of regulating the treatment system flow to maintain a steady drawdown level in well UC22. The flow is regulated by an automatic valve: Model EA20 electric actuator and ball valve (auto-control valve) manufactured by George Fischer Signet, Inc., Tustin, California. By maintaining a steady drawdown level in the well, a steady zone of capture is maintained. The valve is controlled by the CR10 interfaced with a SDM A04 4-channel analog output device (SDM A04). The SDM A04 is manufactured by Campbell Scientific, and serves as the power input device that controls the range of operation of the valve.

Upon initial system start-up and during subsequent start-ups, the auto-control valve (B1) is controlled by input from the flow sensor (Data Industrial Model # 228 B). The flow signal monitored by the data logger is proportionalized to output an analog signal to the auto-control valve. The anticipated range of operation of the auto-control valve is maintained by the signal from the flow monitor until the drawdown elevation in UC22 reaches 15 feet NGVD, the "trigger" elevation. When the "trigger elevation" is indicated, the auto-control valve control becomes controlled by readings from the pressure transducer in UC22. The purpose of this alternate control arrangement is to prevent the high water level readings during initial drawdown (start-up) from signaling the auto control valve to open fully, potentially allowing unacceptably high flow rates through the treatment system.

The CR10 records the drawdown level in UC22 through a Druck (model # PDCR 940) pressure transducer. An offset has been applied to the Druck signal, which converts it to an actual elevation reading referenced to a benchmark elevation at the top of casing of UC22. Once the Druck signal has been recorded and processed, the CR10 initiates an output signal via the SDM A04. It is this output signal that controls the valve.

The battery whose voltage is being monitored by the data logger is the primary power source for the data logger. This battery is continually being re-charged by an AC transformer unless there is a power outage at the site in which case, the battery voltage will slowly be depleted.

Data logger panel temperature is monitored to insure that the data logger manufacturer's recommended operational temperature range is not exceeded.

Daily data summary storage is provided so that average and total readings for each day of operation can be retrieved, downloaded and reviewed on a periodic basis. The methods for data management are described in detail in Section 3.2.

2.7.2 Critical Alarm Control Functions

The procedure that the CR10 implements after detecting a critical alarm is to first drop power to Pump P1 in UC22, then initiate a telephone call to the system operator's pager, and thirdly, record the date, time, and general source of the alarm. The alarms are indicated either from sensors wired directly to the data logger, or from a central annunciator panel connected to external relays from various components of the treatment system. One of the sensors that monitors for an alarm condition is the Data Industrial 228-B flow sensor. The flow sensor is monitored through a pulse count channel of the CR10.

The external circuitry (*i.e.*, electrode/relays) is monitored through a control port in the CR10 data logger that is wired to the main circuit board of the 910 Annunciator, which allows external identification of the source of an alarm by an illuminated LED.

Low Flow measurement. This alarm is tripped when less than 5 gpm is indicated by the flow sensor. There is a one-minute delay prior to shutting off Pump P1 to allow verification of the no flow condition (*i.e.*, the sensor is re-read).

High-level backwash tank electrodes. A critical alarm of high water in the backwash tank will be indicated by a closure signal from electrodes mounted 10 feet above tank bottom. This alarm is very similar to the floor sump alarm, in that normal operation will be indicated by an open circuit in the main indicator panel. The CR10 will respond in the same manner when this alarm is tripped.

Pressure relief flow switch and floor sump electrodes. These two alarms are actually critical alarms, but since they will operate independently of the data logger, the only way to notify the operator of the event and to record when they have been activated is to connect a parallel wire from a relay to Control Port in the data logger to monitor if the relay has been tripped due to either of these events. The response by the data logger will be the same as if a non-critical alarm had occurred, *i.e.,* initiation of an alarm telephone call and storing of the date, time and general source of the alarm; the only difference is that the system will have been shut down already automatically as described below.

A ¾-inch pressure relief valve (100 psi) is located upstream of the auto-control valve. A flow switch located in the ¾-inch pressure relief discharge pipe will also shut down the well pump by direct wiring to the relay that controls Pump P1.

There are electrodes installed in the floor sump in the treatment room at an elevation 6 inches below the finished floor elevation. If a leak occurs that results in the floor sump filling up, the electrode contact is closed and the signal will drop power to Pump P1 via the control relay.

The relays from the floor sump electrodes and pressure relief flow switch are wired to the Control Port that monitors the non-critical alarm modes. Therefore, when these mechanisms are tripped, the event will be recorded in the data logger, and notification made in the manner described in Section 2.7.3. A review of the system operating parameters from a modem link will indicate if the pump was dropped or the alarm was non-critical. The procedure for conducting this review is provided in Appendix C.

2.7.3 Non-Critical Alarm Functions.

A non-critical alarm is of a magnitude that does not warrant a system shutdown, but requires notification of what the condition is and when it has occurred so that when the Operator arrives, the condition can be remedied. Detection of non-critical alarms by the data logger will be necessary to provide time keeping of when this type of alarm has occurred. The response by the data logger to a non-critical alarm is to implement a programmed routine that includes initiation of a telephone call, and the storing of the date, time and general source of the alarm.

Low temperature in treatment room. The CR10 monitors the temperature in the treatment room via a temperature probe. If the room temperature should fall below the set point, indicating the potential for freezing problems in the treatment room the data logger will implement the non-critical alarm response routine. The set point for the low treatment room temperature alarm is provided in Table 2-1.

Table 2-1 Data Logger Measurement & Control Functions

Routine Functions		
Function	*Device*	*Normal Operating Condition*
Flow control	Auto Control Valve (B1)	Approx 2500mV signal from data logger
Pump control	Pump relay	
Measure carbon tank pressures	Pressure transducers at carbon tanks	7 to 15 psig
Measure influent pressure at multi-media filter (MMF)	Pressure transducer at MMF	40 to 100 psig
Measure drawdown in UC22	Pressure transducer in UC22	15 ft NGVD
Measure system flow	Flow Sensor/Monitor	40 to 50 gpm
Measure battery voltage	Data logger	9.6 to 13.4 volts DC
Monitor room temperature	Temperature sensor	50 to 80 °F
Store select data	Data logger	

Critical Alarm Functions		
Function	*Device*	*Set Point*
Low Influent Flow	Flow sensor/monitor	≤5 gpm
High water in Backwash tank	Level electrode in tank	10 feet above tank bottom
Response: 1. Pulse relay to shut down P1 2. Initiate pager call, send code 222222 3. Record date, time source of alarm		

Non- Critical Alarm Functions		
Function	*Device*	*Set Point*
Pressure Relief Valve opens[1]	Flow switch at PRV	>100 psig
High water in floor sump[1]	Level electrode in sump	6 inches below floor elevation
Low treatment room temperature	Temperature sensor	≤35 °F
Water level in UC22	Pressure transducer in UC22	>25 ft NGVD for >60 mins
Response: 1. Initiate pager call, send code 666666 (If water level >25 feet, send 777777) 2. Record date, time source of alarm		

[1] Pump P1 (UC22) already shut down by separate circuit.

3 SYSTEM START-UP, OPERATION & TROUBLE SHOOTING

3.1 START-UP REQUIREMENTS

The treatment system was designed and constructed to allow for easy start-ups with minimal operator involvement. A diaphragm check valve at the inlet to the system eliminates pressure surges through the treatment system that may occur upon well pump start-up. This eliminates the need to slowly open a valve manually when charging the system. The initial signal sent to the auto control valve from the data logger sets it at 100 % open. Once flow begins, the valve will close to about 50% at 50 gpm. Treatment is provided by a series of carbon tanks. The flow from the last carbon tank passes through an elevated section of pipe prior to discharging into the discharge tank. This prevents any draining or siphoning of the carbon tanks and other equipment during shutdown periods, making refilling or venting generally unnecessary. There is no need to close any valves or perform any other actions upon shutdown.

A general start-up procedure is provided below. The procedure is for normal start-ups and shutdowns and for restart after a short shutdown. To restart the system after an extended shutdown it is recommended that the Operator consult with the Design Engineer. Although the procedure is expected to be the same, there may be special conditions resulting from the cause of the extended shutdown that may need to be considered. Similarly, if an extended shut down is anticipated, the Operator should consult with the Design Engineer, to determine what special precautions (if any) should be taken. These actions are likely to be specific to the nature and duration of the extended shutdown.

3.1.1 Start-up Procedures

I. Normal Operating Valve Configuration

1) Using the Initial and Normal Operating Valve Position Schedule located at the end of Appendix D, verify that the system's valves are configured for normal operations. The data logger has a battery back-up that will provide the signal to set the auto control valve 100% open in the absence of electrical power. View the indicator on the auto control valve to verify it is 100% open.

II. Normal Electrical Systems Configuration

1) All the circuit breakers in Panel PP1 must be in the "on" position with the exception of breakers #15, 19 [and UV breakers] which are spares and should be kept "off". The circuits controlled by the various breakers are noted on the inside of the panel door.

2) The starters for the well pump (P1) must be in the "auto" position. The backwash pump (P4) and the reinject pump (P5) must be in the "auto" position to use the hand held start switches at the pumps. The pump (P5) circuit must be reset at the starter

after each automatic shutdown triggered by the low level electrodes in the backwash settling tank.

III. Initial Filling and Venting

1) There is no requirement to fill and/or vent treatment system piping and equipment during normal start-ups.

2) Replacement of spent carbon will require draining water from the unit and filling it with new carbon. A procedure for carbon tank replacement is provided in Section 3.6.

IV. Normal Start-up

1) Reset the pump starter circuit and energize well pump P1 by pressing the start button on the pump motor starter (the indicator must be in the "auto" position). The red run pilot light will be lit acknowledging the motor power circuit is complete. Flow and pressure within the treatment system will occur almost immediately. A normal inlet pressure of 40 to 110 psi should be observed on the inlet pressure gauge. The flow monitor should indicate a flow rate between 30 and 50 gpm.

2) Enable the alarm detection modes of the data logger.

V. Start-up After Critical Alarm Condition.

1) Disable the alarm detection modes of the data logger.

2) Acknowledge and reset the Annunciator noting which indicator light is lit.

3) Determine and correct the cause of the critical alarm.

4) Reset the starter control circuit for the well pump (P1) motor by pushing the pump control reset button.

5) Follow the procedures for normal start-up in Part IV above.

VI. Normal Shutdown Procedures

1) Prior to initiating a planned shutdown disable the alarm detection modes of the data logger.

2) Shutdown the well pump (P1) by turning the indicator switch on the motor starter to the "off" position.

3.2 OVERALL SYSTEM MONITORING

Each inspection tour will include checking the system from the pumping well to the discharge point for upset conditions, and operational or maintenance requirements. During each inspection tour an inspection log will be filled out detailing the field observations including any problems that need to be addressed and what actions were taken. A field operation log form is included in Appendix C. Experience has found that the weekly inspection tour frequency is adequate.

In addition to the scheduled facility inspections, the system is monitored from a remote location through the data logger on the site, via modem at a remote facility. Data such as flow rates, pressures, and drawdown will be reviewed. Following is a summary of the information that the data logger will be reading:

- Elapsed day (Julian day)
- Water level elevation in UC22 (datum is a bench-mark in a notch on top of the 1-inch polyethylene water level monitoring pipe which is 85.525 feet NGVD).
- Volts (Data logger battery pack) which should be greater than 9.6.
- Panel Temperature (acceptable range for the data logger is 13°F to 122°F)
- Carbon pressure at the inlet to the carbon tanks (max design pressure is 12 psi)
- Carbon pressure between the primary and secondary carbon tanks
- Carbon pressure between the secondary and tertiary carbon tanks
- Pressure at the inlet to the multi-media filter
- Flow rate in gpm
- Alarm call: the cumulative number of alarm call-out events to date.
- Annunciator: a reading of 0 indicates that the alarm circuits are all open, a reading of 8 or 16 indicates that one of the alarm circuits are closed.
- mV- Output signal: signal to auto control valve. Range is 0 mV (closed) to 5000 mV (fully open).
- Treatment room temperature

The data logger has a scan rate of 60 seconds on all parameters. The instantaneous readings can be read at the site by calling up the individual parameters via the key pad at the data logger, or from a remote computer via a modem and the telephone line.

The 60 second readings are processed at the top of each hour and stored as follows:

Average water level in UC 22
Average carbon pressure upstream of Carbon #1
Average carbon pressure between Carbon #1 and Carbon #2
Average carbon pressure between Carbon #2 and Carbon #3
Average multi-media filter influent pressure
Total gallons
Instantaneous battery pack volts
Instantaneous panel temperature

Every 24 hours (at 12:00 AM) the data is further processed and stored as follows:

- Year
- Calendar day
- Time of data processing
- Average water level in UC 22
- Maximum and minimum water level in UC 22, and associated times.
- Average carbon pressure upstream of Carbon #1
- Average carbon pressure between Primary and Secondary Carbon
- Average carbon pressure between Secondary & Tertiary Carbon
- Average multi-media filter influent pressure
- Maximum and minimum carbon pressure, and associated times.
- Total gallons
- Average Flow Rate in GPM
- Maximum and minimum flow rates, and associated times.
- Average battery pack volts
- Average panel temperature.

The treatment room temperature is not stored by the data logger. The data logger continually monitors the temperature to compare to the low room temperature alarm set point.

The hourly and daily summary data will be retrieved from the data logger via modem over a telephone line and automatically dropped into a local area network (LAN) computer file.

The calibration of the system sensors is to be verified on a quarterly basis. The Quarterly Sensor Calibration checklist for performing this verification is included in Appendix C.

3.3 WELL PUMP

The well pump is designed to operate continuously without maintenance requirements and should provide years of unattended operation. The current well pump was installed in June 2002. New plastic well piping was installed in 2006. Following are potential well pump failure scenarios and the appropriate Operator responses.

<u>Well Pump Failure</u>

Nature of Failure: Failure or significantly reduced performance of the well pump would result in a complete loss of flow and pressure to the treatment system. This condition can result from an area power failure, pump motor burn-out, or a shut-down signal from one of the critical alarm functions. The flow sensor will read no flow, the well pressure transducer will show a rapid recovery in UC22, and the in-line Druck will show a loss of pressure. All of these sensor outputs will cause the data logger to interrupt power to the pump and notify the operator of an upset condition.

Operator Response: The operator should first determine if the failure is a result of an area or building power failure or specific to the treatment system. If power failure is regional, the operator should contact NStar to report the power outage. If the power failure is localized to the building or the treatment system, the operator should contact a licensed electrician to diagnose and correct the problem. Follow-up phone calls should also be made to the Design Engineer and/or the Project Coordinator.

If the failure is the result of the well pump or pump motor failing, the operator should contact a licensed well pump installer to pull and replace the pump with an equal unit. Follow-up phone calls should also be made to the Design Engineer and/or the Project Coordinator.

3.4 BACKWASH PROCEDURES

Backwash of the multi-media filter and the activated carbon tanks will be required on a periodic basis to remove solids built up that create excessive pressure drop across the filters. The decision to backwash a particular filter will be made based on the pressure drop across the filter as recorded during the periodic inspections or via remote monitoring. A description of the backwash procedures is provided in the following sections. References are made to various valves and pumps which are described in the valve and equipment schedule in Appendix D. Valve and pump designations indicated in the schedule are shown in their actual physical location on the drawings listed in Appendix A, and in their functional location on the Process and Control Diagram provided in Appendix A.

3.4.1 Multi-media Filter

Backwash of the multi-media filter must be initiated if the pressure differential between the influent and discharge lines exceeds 18 psi. The filter may need to be backwashed before the maximum allowable pressure drop is achieved to maintain the desired draw-down level in the extraction well. During backwash the filter is taken off-line with the flow being bypassed or alternatively the extraction and treatment system is shut down for the duration of the backwash (approximately 10-20 minutes). The water used for the backwash feed comes from the system discharge tank. This water has been treated through the system and is stored in the tank prior to discharge. An adequate volume of water must be accumulated in the discharge tank for the backwash by closing valve B16 for a period before shutting down the system. The multi-media filter automatically restricts backwash flow to approximately 75 gpm, therefore approximately 1,500 gallons; or, at a 330 gallons per foot of water depth, 4.5 feet of water depth is required for a 20 minute backwash. The depth of water in the discharge tank should not be less than 1 foot at any time during backwashing events to prevent damage to the backwash pump (P4). The backwash discharge water flows to the backwash tank where suspended solids are allowed to settle out prior to reinjection of the supernatant.

Instructions for loading and unloading the filter can be found in the manufacturer's literature in Appendix E.

The following procedure should be followed when backwashing the multi-media filter.

I. Bypass the multi media filter
  1) Observe and record current flow rate from flow monitor.
  2) Open bypass valve number G2.
  3) Close influent valve number B2.
  4) Close effluent valve number B4.
  5) Adjust valve number G2 to maintain the initial flow rate observed.

II. Set valves at multi media filter for backwash
  1) Close influent valve number Fl.
  2) Open backwash discharge valve number F3.

III. Set valves at pump P4 for backwash
  1) Open valve number B20 on pump discharge.
  2) Close system discharge valve number B16.
  3) Open suction valves numbers B15 and B17.
  4) Check that valve number G3 is closed.

IV. Backwash the multi media filter
  1) Record initial water level in backwash settling tank via the tank site tube.
  2) Start pump P4 and record discharge pressure (normal discharge pressure should be approximately 40 psig).
  3) Run pump P4 for 15 to 20 minutes or until backwash effluent is clear.
  4) Stop pump P4 and record final level in backwash settling tank.

V. Reset valves at pump P4
  1) Close valve number B20 on pump discharge.
  2) Open system discharge valves number B16.
  3) Close suction valves number Bl5 and B17.

VI. Set multi media filter valves for operation
  1) Close backwash discharge valves number F3.
  2) Open influent valve number Fl.

VII. Direct flow through multi media filter
  1) Open effluent valve number B4.
  2) Open influent valve number B2.
  3) Close bypass valve G2.
  4) Record pressure differential.

3.4.2 Carbon Tanks

Each of the four carbon tanks may be operated and/or backwashed independently. The tanks are to be operated in a series of three. When operated in series, the flow is redirected to the next tank via a flexible hose.

Backwash of each carbon tank should be initiated if the influent pressure line exceeds 12 psi. When a new tank is initially placed on line, the carbon manufacturer recommends initial backwashing.

A newly-filled tank can be backwashed while the System is operating. The water used for the backwash feed comes from the system discharge tank. This water has been treated through the system and is stored in the tank prior to discharge. An adequate volume of water must be accumulated in the discharge tank for the backwash by closing valve B16 for a period prior to shutting down the system. At a carbon backwash flow rate of approximately 50 gpm, the required volume of water is approximately 1,000 gallons per carbon tank; or, at a 330 gallons per foot of water depth, 3.5 feet of minimum water depth is required for a 20 minute backwash. The depth of water in the discharge tank should not be less than 1 foot at any time during backwashing events to prevent damage to the backwash pump. The backwash discharge water is returned to the backwash settling tank where suspended solids are allowed to settle out prior to reinjection of the supernatant back into the treatment system. Each backwash event should be recorded on the Treatment System Operation Log (Appendix C).

A detailed description of carbon tank backwash procedures is provided below. These procedures assume that a given carbon tank is being backwashed while flow to the other three tanks is maintained. In the example, the valve settings for backwash of any carbon tank are described.

I. Configure the tank
   1) Close influent valve leading to the top of the tank.
   2) Close effluent valve leading from the bottom of the tank.
   3) Install a flexible hose from the backwash influent to the bottom of the tank.
   4) Install a flexible hose from the backwash effluent to the top of the tank.
   5) Open influent valve leading to the top of the tank.
   6) Open effluent valve leading from the bottom of the tank.

II. Set valves for backwash
   1) Open valve number B25 on backwash pump (P4) discharge.
   2) Open valve number G3 a half of a turn.
   3) Close system discharge valve number B16.
   4) Open suction valves numbers B15 and B17.
   5) Check that valve number B20 is closed.
   6) Open backwash influent and effluent valves B23 and B24

III Backwash the carbon tank
   1) Record initial level in backwash settling tank via the adjacent sight tube.
   2) Start Pump P4 and observe flow rate and record initial time.

3) Adjust valve number G3 for a backwash flow rate of approximately 40 gpm. Under no circumstances should the backwash flow rate exceed 50 gpm.
4) Run pump P4 for 10 to 15 minutes or until backwash effluent is clear. Some carbon fines may be present in the effluent at the end of the backwash cycle.
5) Stop pump P4 and record final level in backwash settling tank and the time.

IV. Reset valves at pump P4

1) Close valves number B25 and G3 on pump P4 discharge.
2) Open system discharge valve number Bl6.
3) Close suction valves number B15 and B17.

V. Redirect flow through carbon tanks.

1) Close backwash influent and effluent valves B23 and B24.
2) Close influent valve leading to the top of the tank.
3) Close effluent valve leading from the bottom of the tank.
4) If the tank was in the process flow, reconfigure flexible hoses for process order.
5) If the tank was in the process flow, record inlet pressure.

3.5 REINJECTION PROCEDURES

The backwash tank accumulates water from backwash of the multi-media filter and the carbon tanks, water from the sump pump and from purge water transfer. Reinjection of the backwash water should be initiated only after adequate time has passed for all of the suspended solids to settle to the bottom of the tank. A sample of the water should be collected from the port on the reinjection pump (P5) suction line in a clear glass container and viewed for clarity to assure adequate settlement has occurred. Reinjection should be accomplished after every carbon and filter backwash and before the next backwash event to not re-suspend the previously settled solids, and to maintain available volume in the tank for future requirements. The supernatant is drawn from the backwash settling tank through a strainer, pumped through a cartridge filter and reinjected into the front-end of the treatment system upstream of the multi media filter. The backwash water is reinjected at approximately 3-5 gallons per minute using Pump P5. The pump is controlled by a pair of low level electrodes that automatically turn the reinjection pump off once the backwash settling tank water elevation is lowered to a pre-set low level. The pump is also controlled by a differential pressure switch that monitors the pressure drop across the cartridge filter. The pump will be automatically shutdown when the differential pressure across the cartridge filter exceeds 15 psi. The filter element should then be cleaned by rinsing, collecting rinsate in a drum designated for this purpose. High-level electrodes in the backwash tank will shut the entire system down and notify the operator of high water level in the backwash tank. (See Appendix A - Process and Control Diagram)

The following procedure should be followed to reinject settled backwash water.

I. Check clarity of water, clean suction strainer and set valves at reinjection pump P5.
1) Close suction valve B19 to isolate the strainer. Remove and clean the sediment strainer on the Pump P5 suction pipe as necessary.
2) Replace sediment strainer and open suction valve B19.
3) Collect a sample in a glass container from the port on the pump suction line. The sample should be free of solids that will settle.
4) Check that Pump P5 discharge valves B22, B27 and B27A are open.

NEVER REINJECT IF MULTI-MEDIA FILTER IS BEING BYPASSED.

II. Reinject the settled backwash water
1) Reset the pump P5 circuit by pressing the reset button on the pump starter located next the electric panel PP1.
2) Start pump P5 and record the time, the pressure on either side of the filter and injection pressure on the operation log.

Pump P5 will automatically stop when the water level in the backwash tank is approximately 2 feet from the bottom. During the next site visit after completion of the reinjection, close all valves at the cartridge filter (B19, B22, B27 and B27A). Pump P5 will also stop automatically if the differential pressure across the filter exceeds 15 psi. This indicates the filter cartridge needs to be cleaned or replaced. (Refer to the manufacturer's installation and operation manual in Volume I of Appendix E.)

3.6 CARBON MEDIA REPLACEMENT

On a periodic basis, the carbon in the primary tank will be exhausted and the media will need to be replaced. The replacement frequency is directly dependent on flow rate and influent concentrations. The series operation of the carbon tanks will theoretically allow the carbon in the first tank to approach saturation without jeopardizing the final effluent discharge limits. The decision to replace the primary tank media will be based on the chemical analyses of water samples taken before and after the primary carbon tank (S5C1 and S5C2, respectively). The decision to change the media in the primary carbon tank will be made by the System Operator. The decision may be reviewed by the Design Engineer or the Project Coordinator. The process will generally involve changing valve positions so that the secondary tank becomes the primary tank and the tertiary tank becomes the secondary tank. The new tertiary tank will be the most-recently serviced carbon tank. The new carbon media will be installed in place of the spent media and the tank will become the off-line spare tank ready to be brought on line when the primary tank is exhausted. The spent carbon will be managed as hazardous waste in accordance with the requirements for a Small Quantity Generator.

In anticipation of changing out the carbon media, the Operator will order and coordinate replacement of the carbon media. Approximately 24 hours or more in advance of the carbon replacement date the Operator will need to reconfigure the tanks directing all flow to the new tank order. The spent carbon tank must then be drained to the floor sump. The sump pump then pumps the water into the backwash settling tank for future reinjection into the treatment system. The spent carbon can then be removed using a vacuum system and packaged for shipping to an appropriate facility. The fresh carbon will then be loaded into the empty tank, saturated and backwashed to prepare it for use. The actual removal and replacement of the carbon media will be performed by the system operator or a contractor specifically engaged to perform those activities.

The following describes the general process for changing flow through the system and preparing a spent carbon tank for servicing. Refer to Table 3-1 for the valve settings for the current process flow and to isolate the offline tank.

I. Shut down the System.
II. Reconfigure the flexible hoses for flow through the tanks in the new process order. Install sample ports S5C1 and S5C2 in the appropriate lines. S5C1 should be installed in the discharge from the primary tank and S5C2 in the discharge from the secondary tank.
III. Restart the System.
VI. Service the spent carbon
    1) Drain spent carbon tank to floor sump.

2) Once the spent tank has drained, coordinate with the contractor who will remove the spent carbon and replace it with fresh media.

VII. Bring carbon tank with fresh media "on-line"

1) Slowly fill (approximately 5 gpm) the unit with municipal water through the manway. Wait at least 24 hours for the carbon to wet and air to be vented.
2) Follow carbon backwash procedures to perform an initial backwash of the tank with the fresh media.

4 CONTINGENCY PLAN

Generally, the required contingencies can be broken down into two major categories: mechanical and remediation type contingencies. Mechanical includes equipment malfunctions or failures, pipe breaks, control malfunctions, etc. Remediation type contingencies include events such as the need to change the design flow rate, increasing contaminant concentrations, and the presence of additional contaminants.

4.1 MECHANICAL CONTINGENCIES

Well Pump. If the well pump fails or its performance is decreased significantly, this condition will be known immediately. Firstly, flow rates will be monitored continuously and the data retrieved on a regular basis through a modem, so a decrease or elimination of flow due to pump failure will be easily recognizable by reviewing the data. Data review will occur daily for the first two weeks of operation, and weekly after that. Additionally, when the flow rate drops below a preset value (initially set at 5 gpm), the data logger will indicate the alarm control mode that will initiate a telephone call to inform personnel of the low flow.

Multi-Media Filter. The only condition that could arise with the filter that would create problems with the treatment system is if an unexpected quantity of suspended solids were present in the influent, and the pressure loss across the filter became excessive. The initial impact of this condition would be the overall decrease in flow rate from the well pump and an increase in-line pressure ahead of the multi-media filter. As with well pump failure, decreased flow would be recognizable when reviewing the flow data retrieved through the modem. If the pressure drop continued to increase dramatically, ultimately the pressure relief valve would open and the flow switch would initiate the alarm mode. If flow were reduced below the low flow set point, the well pump would be shut down via the critical alarm mode.

Granular Activated Carbon. The only mode of failure for the carbon tanks is break-through or over-pressure. Although expected to be very infrequent, break-through of contaminants is an expected occurrence. The carbon will remove all of the VOCs in the influent. VOC monitoring will provide the information needed to identify break-through. This monitoring is described in Section 7.0. Breakthrough from the carbon is not a compliance issue, but rather an operational issue that notifies the operator that the carbon needs to be changed so that adequate adsorption capacity is available. Once breakthrough is observed, replacement carbon will be immediately ordered and the carbon media in the primary tank replaced as soon as possible.

The other potential mode of failure for the carbon tanks is another operational feature: excessive back pressure up-stream of the carbon tanks. Pressure transducers are located on the influent to each of the operating carbon tanks and wired to the datalogger for monitoring. On-going pressure readings should be reviewed regularly off-site through the modem. In this way, backwash requirements can be anticipated by observing the increasing pressure.

<u>Pipe Rupture/Fitting Leaks</u>. If this event occurs, the leaking water will be collected in the trench drains in the treatment room, where it will flow to the collection sump, and be pumped into the backwash settling tank. If the leak rate exceeds the capacity of the sump pump, high level electrodes in the sump will send a signal to the data logger which will initiate the critical alarm function. Similarly, if the water level in the backwash tank reaches high level probes in the tank, the same alarm function will be initiated.

4.2 REMEDIATION TYPE CONTINGENCIES

<u>Hydraulic Modifications</u>. There is the possibility that after pumping for a period of time and monitoring water level elevations in areal wells, it is determined that the pumping flow rate must be adjusted. The flow rate can be decreased without affecting the treatment system. If the flow rate needs to be increased this is possible with the well pump currently installed. The throttling valve can be adjusted to reduce the pressure on the pump, which will allow it to pump up to about 50 gpm. All of the pipes, tanks, and pieces of equipment can hydraulically handle flows higher than 50 gpm, if needed. The carbon tanks each have a hydraulic capacity of 50 gpm.

<u>Increased VOC Concentrations</u>. Influent concentrations have been declining since the system began operation; however, if increased concentrations are found, the carbon can easily be changed more frequently.

<u>Additional Volatile Organic Compounds</u>. Volatile organic data from areal well samples collected during the pilot treatability test did not indicate the presence of any additional compounds that were not detected in the pumped ground water from UC22. Should additional compounds that are not removed by carbon be detected, an evaluation of the removal system could be undertaken.

4.3 CRITERIA FOR TRIGGERING CORRECTIVE ACTION

4.3.1 <u>Treatment</u>

The corrective action for the detection of any VOC at concentrations exceeding the discharge limits in the final discharge after the carbon tanks will be the immediate initiation of change-out of the carbon.

4.3.2 Extraction

The extent of the zone of capture effected by pumping UC22 has demonstrated sustained capture of the UniFirst and Grace source areas. The zone of capture for UC22 may be reduced pending the result of work such as the Combined Effects report, which is required by the Decree.

In the event of a failure of the well pump to maintain the required flowrate, or a complete failure, the corrective action will be to immediately purchase a replacement pump and have it installed.

5 SYSTEM MAINTENANCE

5.1 WEEKLY INSPECTIONS

The treatment system will be inspected on a weekly basis. Any failures, faults or unusual observations will be investigated fully. Any equipment that is found to be faulty, out of adjustment, or in disrepair will be repaired or serviced. Manufacturer's information for the major pieces of equipment is provided in Appendix E. In general, very little on-going maintenance is required for the pieces of equipment utilized in this treatment system. Some recommendations for periodic inspection of the system are presented below.

A. Well Head and Influent Line
   Inspect the well head for evidence of tampering or damage to the well head cap.
B. Data Logger
   Check the data logger for evidence of tampering, short circuits, or possible exposure to excessive moisture.
C. Carbon Tanks
   Check the carbon tanks for leakage, damage or corrosion at the influent, discharge, and drain connections. Inspect the flexible hoses for leakage and damage.
D. Backwash and Reinjection Pumps
   Inspect each pump for worn parts, burn marks, excessive heat and general pump performance. Electrical connections should be checked for damage or evidence of short circuits.
E. Hazardous Waste Storage Area
   Inspect the condition of the drums of spent carbon, the labels and the general condition of the waste storage area. Record the findings on the log sheet.

5.2 ANNUAL SYSTEM INSPECTION

The system operator will perform and document annual inspection tasks. The documentation will consist of completing an annual inspection checklist. The checklist is included in Appendix C. The annual system inspection will generally include the following activities;

- Visual inspection of the wellhead at UC22
- Visual inspection and replacement, as needed, of the desiccant in the pressure transducer junction box at the wellhead at UC22
- Visual inspection of the influent and discharge pipe corridors
- Opening and inspecting the two "at-grade" cleanouts on the discharge pipe
- Visual inspection of conditions at the outfall to the Aberjona
- Visual inspection and exercising of all valves in the treatment system
- Visual inspection of treatment system piping and fittings
- Testing of the emergency eyewash and shower and exercising valves on the municipal water piping of the treatment area
- Visually inspect all the treatment system equipment and valve identification tags and replace as needed. Spare tyvek tags and nylon ties are available at the site.
- Visually inspect all tankage, which includes the multi-media filter, the carbon tanks, the backwash settling tank and discharge tank.
- Test the sump pump operation and inspect pump, float and power leads. Clean suction screen on the bottom of the pump.
- Backwash of multi-media filter if not previously performed during the year.
- Inspect and test the pressure relief valve and flow switch
- Inspect and test the high level electrodes in the floor sump and backwash settling tank
- Inspect the floor water seal and containment curbs in the treatment room
- Inventory emergency response equipment and arrange for replacements as needed
- Inventory spare parts for system components and arrange for replacements as needed
- Replacement of the desiccant within the data logger enclosure
- Inspect the cartridge filter and clean the filter element, if necessary.

The results of the inspection (the checklist) and any recommendations resulting from observations during the inspection activities will be submitted to the Design Engineer for review and inclusion in the annual report. The inspection is to be performed during September of each year.

5.3 ANNUAL PLANNED EQUIPMENT MAINTENANCE

The treatment system operator will coordinate and oversee the completion of certain annual maintenance tasks to be performed by a Massachusetts licensed master plumber. These include, but are necessarily limited to the inspection of the diaphragm check valve and pressure regulator.

Rebuild kits for the diaphragm check valve and pressure regulator will be available on site for use should the inspection of these items indicate worn or damaged parts. The plumber may also need to perform necessary maintenance on the backwash and reinject pumps, if the annual inspection indicates such action is needed. Spares for those parts prone to wear are stored on site.

Certification that the planned equipment maintenance was completed as per the O&M plan will be required for inclusion in the Annual Report. This certification will be comprised of completing the Annual Planned Maintenance Checklist included in Appendix C. The planned equipment maintenance is to be performed during the later part of September of each year.

5.4 CONSUMABLE AND SPARE PARTS

5.4.1 Consumable Parts

There are very few moving parts to the System. The majority of the hardware incorporated into the system is likely to perform for the projected duration of the remedial action. Two exceptions are the diaphragm check valve and the pressure-reducing valve. There are components of these valves that wear due to the erosive action of the process flow stream. The parts in these valves will be inspected and replaced as needed on an annual basis. A checklist developed for this annual planned maintenance is included in Appendix C.

The following replacement parts are available at the site for these valves. Any parts used during the annual planned maintenance must be replaced.

- Watts Pressure Regulator - Model 223LP-1½"
  Repair Kit # 1½ 223 RK contains:
  Diaphragm, Disc, Disc screw, Seat, Seat gasket, Bottom plug gasket

- CLA-VAL Diaphragm Check Valve - Model 81-01-2"
  Replacement parts on hand:
  Diaphragm, Disc, Seat 0-ring.

5.4.2 Spare Parts

Following is a list of spare parts stored at the treatment plant site. This list should be reviewed annually and the parts inventoried. Any parts used should be replaced as soon as possible.

1	100 psi - 1" pressure relief valve
2	2" Face flange gaskets
2	2" Face flange bolts and nuts

2	2" Cam-lock female coupler gaskets
-	Tyvek tags and nylon ties
1	2" PVC true-union ball valve

Replacement parts are also available on site for the backwash (P4) and the reinject (P5) pumps. These pumps operate on a very infrequent basis and part wear is anticipated to be minor. Refer to the manufacturer's literature in Appendix E for parts list and cut away views of the pumps. These pumps and their parts are distributed by Blake Equipment Company (800-287-0865). Following is a list of the repair parts available at the site for these pumps.

Backwash Pump (P4) by "Burks Pumps" 3 hp - 208 volt,3Θ, Model 330GA6-1½

Description	Part #	Part I.D. # in Manufacturer's cut away view
Shaft seal	9917	15
O-ring gasket	22006	12
Shaft sleeve	22063	16
Slinger washer	9918	3
O-ring gasket	22080	9
O-ring gasket	22083	11

Reinjection Pump (P5) by "Burks Pumps" hp - 208 volt, 1Θ, Model 34CS6M

Description	Part #	Part I.D. # in Manufacturer's cut away view
Impeller	SA-9788-6	23
Raceway	9789-6	22
O-ring gasket	9791	13

6 SITE SECURITY PLAN

The site security procedures outlined in this plan are designed to prevent the unknowing entry, and minimize the possibility of unauthorized entry of persons onto this site during active remediation. The site security procedures outlined herein will also provide insurance that unknowing or unauthorized persons do not come in physical contact with wastes, structures, or equipment that have the potential to cause injury or adverse health effects.

Authorized activities at the site include operation and maintenance of the pumping and treatment equipment and sampling of the water being treated.

6.1 SITE DESCRIPTION

The existing facility at this site is a large warehouse-type structure with the majority of space being utilized as rentable self-storage units. The facility is manned by personnel of the self-storage company from the hours of 9:30 AM to 6:00 PM. The site is encircled by a security fence. The southern property line is Olympia Avenue, and western property line is the top of a retaining wall that is approximately two feet high on the southern end and six feet high on the northern end. The security fence is installed on top of this retaining wall. The northern property line is the right-of-way for Interstate 95/Route 128. The remainder of the property adjoins private residences.

6.2 SITE CONTROLS AND SIGNAGE

Access to the property is controlled by the existence of the security fence that surrounds the facility and a locking gate. During normal business hours, 9:30 AM to 6:00 PM, access to the property is controlled by the personnel of the self-storage facility.

The treatment system is located to afford minimal exposure to the general public. Since the entire system is located inside the existing building, the only evidence of activity on-site is the existing well head. All influent and effluent plumbing associated with the treatment system is underground.

The treatment room is secured and isolated by locking doors. Only authorized personnel have keys to obtain access to the site and the treatment room. At each entrance to the treatment room a permanent sign has been affixed with the following legend: Danger - Unauthorized Personnel Keep Out". This sign is legible from a distance of at least 25 feet.

7 LONG-TERM SAMPLING, ANALYSIS AND REPORTING

7.1 REMEDIATION GOALS

The remediation goals for the UniFirst site are essentially defined in the EPA Administrative Order as the remedial objectives. These objectives are:

1) Prevent further migration of contaminated ground water from the source areas to the central area
2) Restore the ground water in the vicinity of the source areas to cleanup levels
3) Prevent public contact with contaminated ground water above the cleanup levels

The clean-up levels referenced in 2) and 3) above are further defined in the Record of Decision and are summarized below:

chloroform	100 μg/L
1,1-Dichloroethane	5 μg/L
1,2-Dichloroethane	5 μg/L
1,1-Dichloroethene	7 μg/L

Tetrachloroethene	5 µg/L
Trichloroethene	5 µg/L
Vinyl chloride	2 µg/L
trans-1,2-Dichloroethene	70 µg/L
1,1,1-Trichloroethane	200 µg/L

7.2 DISCHARGE LIMITS

The discharge limits for the treated water being discharged from this system have been established as follows:

Monthly Average	(µg/L)
Tetrachloroethene	5
Trichloroethene	5
Carbon Tetrachloride	5
1,1 Dichloroethene	7
1,2 Dichloroethene	70
Benzene	5
Lead	10.2 mg/L*

* Based on a hardness of 105 mg/L $CaCO_3$ in the Aberjona River. Maximum discharge limit for lead is 87 µg/L at any point in time (also based on 105 mg/L of $CaC0_3$).

7.3 SAMPLING AND ANALYSIS

7.3.1 Treatment Plant

The frequency of sample collection and parameters to be analyzed for monitoring treatment system operation and compliance with discharge limits is summarized in Table 7-1. The location of the sampling points is shown on Figure 1-2. All samples will be collected, labeled, stored, shipped and analyzed in accordance with the procedures outline in the Quality Assurance/Quality Control Plan for this treatment plant. If discharge sample results indicate violations of any of the discharge limits, a repeat sample for the problem analyte will be initiated. If there is still a violation, the problem must be resolved within 48 hours or the plant must be shut down, and the problem identified and resolved. Upon problem resolution, and/or plant start-up, another sample must be taken immediately.

Table 7-1 Treatment Plant Sampling Frequency

Sample Location	Analyte/Method	Frequency
Influent (S1)	VOC/8260	Bi-Monthly
Between 1st and 2nd Carbon (S5C1)	VOC/8260	Monthly
Between 2nd and 3rd Carbon (S5C2)	VOC/8260	Monthly

Discharge (S6)	VOC/524.2 Lead/200.7 Full TCL/TAL List	Monthly[1] Monthly Annually (May)

Following is a written description of the sampling and analysis requirements for the individual sample locations.

Discharge

Samples of the discharge from the treatment system will be taken from the sample tap labeled S6 located on the discharge line from the final discharge tank. The discharge will be sampled on a monthly basis (depending upon the data) and analyzed for volatile organic compounds via EPA Method 524.2 and lead via EPA Method 200.7. In addition, the full TCL/TAL analyte list will be analyzed for on an annual basis.

Influent

The system influent samples will be taken from the sample tap labeled S1 located immediately downstream of the influent flow sensor and immediately upstream of the Multi-Media filter.

The sampling and analysis for volatile organic compounds will be done using EPA Method 8260.

Between Carbon Tanks

When the order of the carbon tanks is changed, the sampling ports will be labeled according to their position in the treatment train.

Samples from between the carbon units (S5C1 and S5C2) will be collected at least monthly, but may be more frequent if the carbon usage rate indicates that a carbon tank will last less than 6 weeks.

Treatment Plant Solids

Collected (*i.e.*, drummed) treatment plant solids will be sampled when approximately 100 kilograms of solids has accumulated. Samples will be collected using a stainless steel trowel or other proven inert sample collection material and containerized in accordance with the Quality Assurance/Quality Control Plan.

The solids will be analyzed for VOCs using EPA Method 8240 and for TAL metals. If these

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[1] Except **if discharge sample results indicate violations of any of the discharge limits,** a repeat sample will be collected. If there is still a violation, the problem must be resolved within 48 hours, or the plant will be shut down, and the problem identified and resolved. Upon problem resolution, another sample must be taken immediately.

totals exceed the total criteria for a TCLP extract, a TCLP test will be conducted, the waste characterized, and disposed of in accordance with RCRA land disposal restrictions. Specific references to analytical methods and quality control and sampling criteria are described in the Quality Assurance/Quality Control Plan.

7.3.2 Ground Water

The long-term ground water monitoring plan for the Northeast Quadrant of the Wells G & H Site consists of ground water level monitoring, and ground water sampling and analysis for the volatile organic compounds identified in the ROD. The monitoring plan includes those wells considered necessary to monitor the ground water capture area for well UC22; to evaluate the efficiency of the extraction and treatment system; and to determine compliance with the clean-up criteria specified in the ROD. The Grace wells to be included in this monitoring plan are discussed in the Grace sampling and analysis plan.

Water Level Monitoring

Ground-water-level monitoring will be conducted annually. This monitoring will be conducted on the monitoring wells listed below, which are considered sufficient to confirm the capture zone area for well UC22 in the unconsolidated deposits, shallow bedrock and deep bedrock. The following list of well locations includes all the monitoring wells in the nested location unless otherwise specified:

Monitoring Wells in the Water Level Monitoring Network

DP1S	S65M	UC9-2	UC22*
DP1D	S65DR	UC9-4	UC23-1
DP2S	S66D	UC9-6	UC23-2
DP2M	S67S	UC10S	UC23-3
DP2D	S67M	UC10M	UC23-4
DP3	S67D	UC10D	UC23-5
DP36	S69D	UC10-1	UC24S
DP37S	S70S	UC10-2	UC24D
DP37D	S70M	UC10-3	UC25
K42S	S70D	UC10-4	UC26S
K42M	S71S	UC10-5	UC26D
K42D	S71D	UC10-6	UC29S
GO1S	S81S	UC11-2	UC29D
GO1D	S81M	UC11-6	UC30
GO1DB	S81D	UC12-1	UC31S
IUS1	S82	UC12-2	UC31M
IUS2A	S97S	UC12-3	UC31D
IUS2B	S97M	UC12-4	UG1-1
IUS2C	S97D	UC12-5	UG1-2

IUS3A	UC4	UC12-6	UG1-3
IUS3B	UC5	UC15S	UG1-4
IUS3C	UC6S	UC15D	UG1-5
S7R	UC6	UC16	UG1-6
S63S	UC7A-1	UC17	UG1-7
S63D	UC7A-2	UC18	UC32
S64S	UC7A-3	UC19S	UC33
S64M	UC7A-4	UC19D	UC34
S64D	UC7A-5	UC19	UC35
S65S	UC8	UC20	UC36

Permanently installed data loggers and pressure transducers are installed in monitoring wells UC22, UC6 and UC6S.

Ground Water Sampling

In 1996, EPA approved annual sampling for volatile organic compounds from the following wells:

Monitoring Wells Sampled for VOC

GO1DB	UC6	UC10-2
S70D	UC6S	UC10-3
S71S	UC7-1	UC10-4
S71D	UC7-2	UC10-5
S81S	UC7-3	UC10-6
S81M	UC7-4	UC10S
S81D	UC7-5	UC10M
UG1-4	UC10-1	UC10D
		UC11-2

Ground water is also being monitored bi-monthly at UC22 by way of the treatment system influent samples described in Section 7.3.1.

7.4 REPORTING

Operational reports will be made to the EPA on a monthly basis (within 10 days of the end of each month), and annual summary reports made within 45 days of the end of each operational year. Operational reports include a summary of operational activities, a summary of analytical data, a graph of the flow, carbon pressure and water level data, field measurements, and a discussion of unusual operational events, adjustments, health and safety measurements and/or observations, and recommendations for continuing operations.

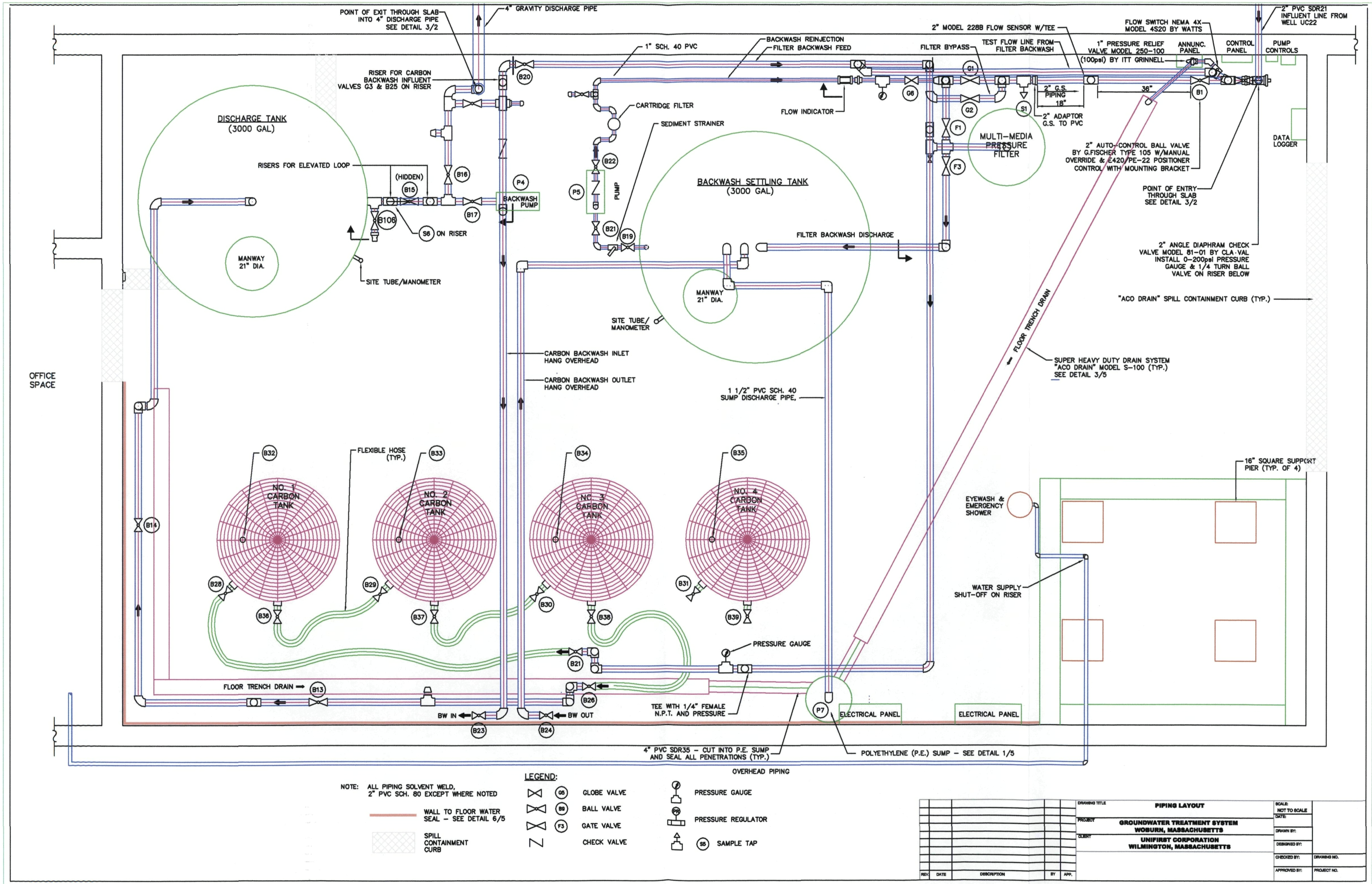
The annual reports contain summaries of all operational and analytical data, discussions of conformance to discharge limits and recommendations for future operational requirements, predictions of carbon use requirements, review of the areal well sampling results, and a discussion regarding comparison of the measured ground water quality versus the clean-up goals as presented in the Record of Decision. In addition, the annual report will include a summary of contaminant mass removed, carbon usage rates, an interpretation of the trends in contaminant concentrations and distributions and recommendations for modifications to the system if necessary. Contaminant concentrations from the individual wells will be presented numerically on the water level contour maps.

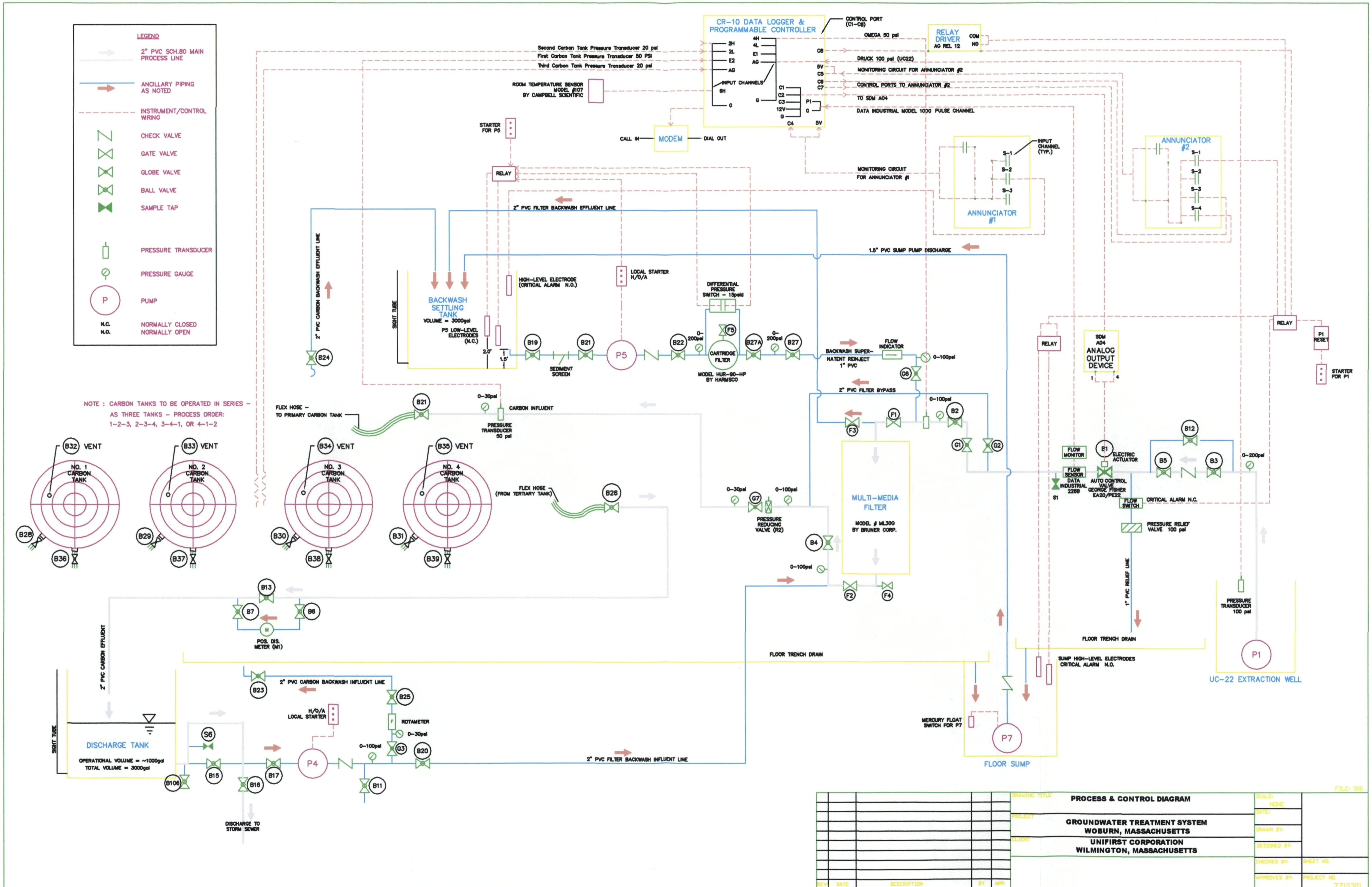
7.5 QUALITY ASSURANCE

Quality Assurance is addressed in the Quality Assurance/Quality Control (QA/QC) Plan that is provided as a separate document. The QA/QC Plan addresses sampling and handling methodology, analytical procedures, data reduction, validation, reporting, and equipment calibration.

Appendix A

Design Drawings


POINT OF EXIT THROUGH SLAB INTO 4" DISCHARGE PIPE SEE DETAIL 3/2
4" GRAVITY DISCHARGE PIPE
2" MODEL 228B FLOW SENSOR W/TEE
FLOW SWITCH NEMA 4X MODEL 4S20 BY WATTS
2" PVC SDR21 INFLUENT LINE FROM WELL UC22
BACKWASH REINJECTION
FILTER BACKWASH FEED
1" SCH. 40 PVC
FILTER BYPASS
TEST FLOW LINE FROM FILTER BACKWASH
1" PRESSURE RELIEF VALVE MODEL 250-100 (100psi) BY ITT GRINNELL
ANNUNC. PANEL
CONTROL PANEL
PUMP CONTROLS
RISER FOR CARBON BACKWASH INFLUENT VALVES G3 & B25 ON RISER
CARTRIDGE FILTER
FLOW INDICATOR
SEDIMENT STRAINER
2" G.S. PIPING
18"
36"
2" ADAPTOR G.S. TO PVC
DISCHARGE TANK
(3000 GAL)
RISERS FOR ELEVATED LOOP
(HIDDEN)
BACKWASH PUMP
PUMP
MULTI-MEDIA PRESSURE FILTER
2" AUTO-CONTROL BALL VALVE BY G.FISCHER TYPE 105 W/MANUAL OVERRIDE & E420/PE-22 POSITIONER CONTROL WITH MOUNTING BRACKET
DATA LOGGER
POINT OF ENTRY THROUGH SLAB SEE DETAIL 3/2
BACKWASH SETTLING TANK
(3000 GAL)
S6 ON RISER
MANWAY 21" DIA.
SITE TUBE/MANOMETER
FILTER BACKWASH DISCHARGE
2" ANGLE DIAPHRAM CHECK VALVE MODEL 81-01 BY CLA-VAL INSTALL 0-200psi PRESSURE GAUGE & 1/4 TURN BALL VALVE ON RISER BELOW
MANWAY 21" DIA.
SITE TUBE/ MANOMETER
"ACO DRAIN" SPILL CONTAINMENT CURB (TYP.)
FLOOR TRENCH DRAIN
SUPER HEAVY DUTY DRAIN SYSTEM "ACO DRAIN" MODEL S-100 (TYP.) SEE DETAIL 3/5
OFFICE SPACE
CARBON BACKWASH INLET HANG OVERHEAD
CARBON BACKWASH OUTLET HANG OVERHEAD
1 1/2" PVC SCH. 40 SUMP DISCHARGE PIPE.
FLEXIBLE HOSE (TYP.)
16" SQUARE SUPPORT PIER (TYP. OF 4)
NO. 1 CARBON TANK
NO. 2 CARBON TANK
NO. 3 CARBON TANK
NO. 4 CARBON TANK
EYEWASH & EMERGENCY SHOWER
WATER SUPPLY SHUT-OFF ON RISER
PRESSURE GAUGE
FLOOR TRENCH DRAIN
BW IN
BW OUT
TEE WITH 1/4" FEMALE N.P.T. AND PRESSURE
ELECTRICAL PANEL
ELECTRICAL PANEL
4" PVC SDR35 - CUT INTO P.E. SUMP AND SEAL ALL PENETRATIONS (TYP.)
POLYETHYLENE (P.E.) SUMP - SEE DETAIL 1/5
OVERHEAD PIPING
B1 B13 B14 B15 B16 B17 B19 B20 B21 B22 B23 B24 B26 B28 B29 B30 B31 B32 B33 B34 B35 B36 B37 B38 B39 B106 G1 G2 G6 F1 F3 S1 S6 P4 P5 P7
NOTE: ALL PIPING SOLVENT WELD, 2" PVC SCH. 80 EXCEPT WHERE NOTED
WALL TO FLOOR WATER SEAL - SEE DETAIL 6/5
SPILL CONTAINMENT CURB
LEGEND:
G6 GLOBE VALVE
B8 BALL VALVE
F3 GATE VALVE
CHECK VALVE
PRESSURE GAUGE
PR PRESSURE REGULATOR
S5 SAMPLE TAP
REV. DATE DESCRIPTION BY APP.
DRAWING TITLE PIPING LAYOUT
PROJECT GROUNDWATER TREATMENT SYSTEM WOBURN, MASSACHUSETTS
CLIENT UNIFIRST CORPORATION WILMINGTON, MASSACHUSETTS
SCALE: NOT TO SCALE
DATE:
DRAWN BY:
DESIGNED BY:
CHECKED BY:
DRAWING NO.
APPROVED BY:
PROJECT NO.



LEGEND
2" PVC SCH.80 MAIN PROCESS LINE
ANCILLARY PIPING AS NOTED
INSTRUMENT/CONTROL WIRING
CHECK VALVE
GATE VALVE
GLOBE VALVE
BALL VALVE
SAMPLE TAP
PRESSURE TRANSDUCER
PRESSURE GAUGE
PUMP
N.C. NORMALLY CLOSED
N.O. NORMALLY OPEN
CR-10 DATA LOGGER & PROGRAMMABLE CONTROLLER
CONTROL PORT (C1-C8)
RELAY DRIVER AG REL 12
OMEGA 50 psi
DRUCK 100 psi (UC22)
MONITORING CIRCUIT FOR ANNUNCIATOR #2
CONTROL PORTS TO ANNUNCIATOR #2
TO SDM A04
DATA INDUSTRIAL MODEL 1030 PULSE CHANNEL
Second Carbon Tank Pressure Transducer 20 psi
First Carbon Tank Pressure Transducer 50 PSI
Third Carbon Tank Pressure Transducer 20 psi
ROOM TEMPERATURE SENSOR MODEL #107 BY CAMPBELL SCIENTIFIC
INPUT CHANNELS
CALL IN
MODEM
DIAL OUT
STARTER FOR P5
RELAY
MONITORING CIRCUIT FOR ANNUNCIATOR #1
INPUT CHANNEL (TYP.)
ANNUNCIATOR #1
ANNUNCIATOR #2
2" PVC FILTER BACKWASH EFFLUENT LINE
1.5" PVC SUMP PUMP DISCHARGE
2" PVC CARBON BACKWASH EFFLUENT LINE
HIGH-LEVEL ELECTRODE (CRITICAL ALARM N.O.)
LOCAL STARTER H/O/A
DIFFERENTIAL PRESSURE SWITCH - 15psid
BACKWASH SETTLING TANK
VOLUME = 3000gal
P5 LOW-LEVEL ELECTRODES (N.C.)
SIGHT TUBE
SEDIMENT SCREEN
CARTRIDGE FILTER
MODEL HUR-90-HP BY HARMSCO
BACKWASH SUPER-NATENT REINJECT 1" PVC
FLOW INDICATOR
2" PVC FILTER BYPASS
RELAY
SDM A04 ANALOG OUTPUT DEVICE
P1 RESET
STARTER FOR P1
NOTE : CARBON TANKS TO BE OPERATED IN SERIES - AS THREE TANKS - PROCESS ORDER: 1-2-3, 2-3-4, 3-4-1, OR 4-1-2
FLEX HOSE - TO PRIMARY CARBON TANK
CARBON INFLUENT
PRESSURE TRANSDUCER 50 psi
NO. 1 CARBON TANK
NO. 2 CARBON TANK
NO. 3 CARBON TANK
NO. 4 CARBON TANK
VENT
FLEX HOSE (FROM TERTIARY TANK)
PRESSURE REDUCING VALVE (R2)
MULTI-MEDIA FILTER
MODEL # ML300 BY BRUNER CORP.
FLOW MONITOR
FLOW SENSOR DATA INDUSTRIAL 228B
ELECTRIC ACTUATOR
AUTO CONTROL VALVE GEORGE FISHER EA20/PE22
FLOW SWITCH
CRITICAL ALARM N.C.
PRESSURE RELIEF VALVE 100 psi
1" PVC RELIEF LINE
PRESSURE TRANSDUCER 100 psi
POS. DIS. METER (M1)
FLOOR TRENCH DRAIN
SUMP HIGH-LEVEL ELECTRODES CRITICAL ALARM N.O.
MERCURY FLOAT SWITCH FOR P7
FLOOR SUMP
UC-22 EXTRACTION WELL
2" PVC CARBON EFFLUENT
2" PVC CARBON BACKWASH INFLUENT LINE
H/O/A LOCAL STARTER
ROTAMETER
DISCHARGE TANK
OPERATIONAL VOLUME = ~1000gal
TOTAL VOLUME = 3000gal
2" PVC FILTER BACKWASH INFLUENT LINE
DISCHARGE TO STORM SEWER
PROCESS & CONTROL DIAGRAM
GROUNDWATER TREATMENT SYSTEM WOBURN, MASSACHUSETTS
UNIFIRST CORPORATION WILMINGTON, MASSACHUSETTS

Appendix B

Data Logger Control Code

```
;{CR10}
*Table 1 Program
  01: 60.0000   Execution Interval
(seconds)

1:  Z=F (P30)
 1: 0          F
 2: 0          Exponent of 10
 3: 29         Z Loc [ _________ ]

2:  Do (P86)
 1: 18         Set Flag 8 High

3:  Set Port(s) (P20)
 1: 6698       C8..C5 =
1sec/1sec/nc/input
 2: 8999       C4..C1 = input/nc/nc/nc

4:  Full Bridge (P6)
 1: 1          Reps
 2: 23         25 mV 60 Hz Rejection
Range
 3: 4          DIFF Channel
 4: 3          Excite all reps w/Exchan
3
 5: 2500       mV Excitation
 6: 2          Loc [ _________ ]
 7: 23.155     Mult
 8: -81.854    Offset

5:  Z=X (P31)
 1: 2          X Loc [ _________ ]
 2: 7          Z Loc [ _________ ]

6:  Z=X (P31)
 1: 2          X Loc [ _________ ]
 2: 31         Z Loc [ _________ ]

7:  Z=X+Y (P33)
 1: 31         X Loc [ _________ ]
 2: 32         Y Loc [ _________ ]
 3: 32         Z Loc [ _________ ]

8:  Full Bridge (P6)
 1: 1          Reps
 2: 23         25 mV 60 Hz Rejection
Range
 3: 2          DIFF Channel
 4: 2          Excite all reps w/Exchan
2
 5: 2500       mV Excitation
 6: 5          Loc [ _________ ]
 7: 5.0469     Mult
 8: .022       Offset

9:  Volt (Diff) (P2)
 1: 1          Reps
 2: 25         2500 mV 60 Hz Rejection
Range
 3: 1          DIFF Channel
 4: 51         Loc [ _________ ]
 5: .6         Mult
 6: 0          Offset

10:  Volt (Diff) (P2)
 1: 1          Reps
 2: 25         2500 mV 60 Hz Rejection
Range
 3: 3          DIFF Channel
 4: 52         Loc [ _________ ]
 5: .6         Mult
 6: 0          Offset

11:  Volt (Diff) (P2)
 1: 1          Reps
 2: 25         2500 mV 60 Hz Rejection
Range
 3: 5          DIFF Channel
 4: 53         Loc [ _________ ]
 5: 2          Mult
 6: 0          Offset

12:  Pulse (P3)
 1: 1          Reps
 2: 1          Pulse Input Channel
 3: 2          Switch Closure, All
Counts
 4: 12         Loc [ _________ ]
 5: .1051      Mult
 6: 0          Offset

13:  Z=X*F (P37)
 1: 12         X Loc [ _________ ]
 2: 1          F
 3: 13         Z Loc [ _________ ]

14:  Z=X (P31)
 1: 13         X Loc [ _________ ]
 2: 8          Z Loc [ _________ ]

15:  Batt Voltage (P10)
 1: 3          Loc [ _________ ]

16:  Temp (107) (P11)
 1: 1          Reps
 2: 11         SE Channel
 3: 1          Excite all reps w/Exchan
1
 4: 4          Loc [ _________ ]
 5: 1.8        Mult
 6: 32         Offset

17:  Do (P86)
 1: 10         Set Output Flag High
```

```
18:  Set Active Storage Area (P80)
 1: 2          Final Storage Area 2
 2: 511        Array ID

19:  Real Time (P77)
 1: 1120       (Same as 1220) Y,D,Hr/Mn

20:  Sample (P70)
 1: 2          Reps
 2: 2          Loc [ __________ ]

21:  Sample (P70)
 1: 1          Reps
 2: 5          Loc [ __________ ]

22:  Sample (P70)
 1: 1          Reps
 2: 13         Loc [ __________ ]

23:  Sample (P70)
 1: 1          Reps
 2: 50         Loc [ __________ ]

24:  Sample (P70)
 1: 1          Reps
 2: 51         Loc [ __________ ]

25:  Sample (P70)
 1: 1          Reps
 2: 52         Loc [ __________ ]

26:  Sample (P70)
 1: 1          Reps
 2: 53         Loc [ __________ ]

27:  Do (P86)
 1: 1          Call Subroutine 1

28:  If time is (P92)
 1: 0          Minutes (Seconds --)
into a
 2: 60         Interval (same units as
above)
 3: 10         Set Output Flag High

29:  Real Time (P77)
 1: 1120       (Same as 1220) Y,D,Hr/Mn

30:  Resolution (P78)
 1: 1          High Resolution

31:  Sample (P70)
 1: 1          Reps
 2: 1          Loc [ __________ ]

32:  Average (P71)
 1: 1          Reps
 2: 2          Loc [ __________ ]

33:  Average (P71)
 1: 1          Reps
 2: 5          Loc [ __________ ]

34:  Totalize (P72)
 1: 1          Reps
 2: 12         Loc [ __________ ]

35:  Average (P71)
 1: 1          Reps
 2: 13         Loc [ __________ ]

36:  Sample (P70)
 1: 1          Reps
 2: 3          Loc [ __________ ]

37:  Average (P71)
 1: 1          Reps
 2: 51         Loc [ __________ ]

38:  Average (P71)
 1: 1          Reps
 2: 52         Loc [ __________ ]

39:  Average (P71)
 1: 1          Reps
 2: 53         Loc [ __________ ]

40:  If time is (P92)
 1: 10         Minutes (Seconds --)
into a
 2: 60         Interval (same units as
above)
 3: 30         Then Do

41:  Z=F (P30)
 1: 60         F
 2: 0          Exponent of 10
 3: 33         Z Loc [ __________ ]

42:  Z=X/Y (P38)
 1: 32         X Loc [ __________ ]
 2: 33         Y Loc [ __________ ]
 3: 34         Z Loc [ __________ ]

43:  Z=F (P30)
 1: 0          F
 2: 0          Exponent of 10
 3: 32         Z Loc [ __________ ]

44:  If (X<=>F) (P89)
 1: 35         X Loc [ __________ ]
 2: 1          =
 3: 0          F
```

```
 4: 30        Then Do

45:  If Flag/Port (P91)
 1: 24        Do if Flag 4 is Low
 2: 30        Then Do

46:  If (X<=>F) (P89)
 1: 34        X Loc [ _________ ]
 2: 3         >=
 3: 25        F
 4: 30        Then Do

47:  Do (P86)
 1: 8         Call Subroutine 8

48:  Initiate Telecommunications
(P97)
 1: 21        Phone Modem/1200 Baud
 2: 0         Never Disabled
 3: 60        Seconds Call Time Limit
 4: 0         Seconds Before Fast
Retry
 5: 0         Fast Retries
 6: 0         Minutes Before Slow
Retry
 7: 26        Failures Loc [ _________
]
 8: 1         Call-Back ID

49:  Extended Parameters (P63)
 1: 1         Option
 2: 8         Option
 3: 0         Option
 4: 0         Option
 5: 3         Option
 6: 9         Option
 7: 1         Option
 8: 3         Option

50:  Extended Parameters (P63)
 1: 0         Option
 2: 3         Option
 3: 6         Option
 4: 44        Option
 5: 44        Option
 6: 44        Option
 7: 44        Option
 8: 7         Option

51:  Extended Parameters (P63)
 1: 7         Option
 2: 7         Option
 3: 7         Option
 4: 7         Option
 5: 7         Option
 6: 7         Option
 7: 7         Option
```

```
 8: 13        Option

52:  End (P95)

53:  End (P95)

54:  End (P95)

55:  End (P95)

56:  If time is (P92)
 1: 0         Minutes (Seconds --)
into a
 2: 1440      Interval (same units as
above)
 3: 10        Set Output Flag High

57:  Real Time (P77)
 1: 1120      (Same as 1220) Y,D,Hr/Mn

58:  Resolution (P78)
 1: 1         High Resolution

59:  Average (P71)
 1: 1         Reps
 2: 2         Loc [ _________ ]

60:  Maximum (P73)
 1: 1         Reps
 2: 10        Value with Hr-Min
 3: 2         Loc [ _________ ]

61:  Minimum (P74)
 1: 1         Reps
 2: 10        Value with Hr-Min
 3: 2         Loc [ _________ ]

62:  Average (P71)
 1: 1         Reps
 2: 5         Loc [ _________ ]

63:  Maximum (P73)
 1: 1         Reps
 2: 10        Value with Hr-Min
 3: 5         Loc [ _________ ]

64:  Minimum (P74)
 1: 1         Reps
 2: 10        Value with Hr-Min
 3: 5         Loc [ _________ ]

65:  Totalize (P72)
 1: 1         Reps
 2: 12        Loc [ _________ ]

66:  Average (P71)
 1: 1         Reps
```

```
 2: 13        Loc [ _________ ]

67:  Maximum (P73)
 1: 1         Reps
 2: 10        Value with Hr-Min
 3: 13        Loc [ _________ ]

68:  Minimum (P74)
 1: 1         Reps
 2: 10        Value with Hr-Min
 3: 13        Loc [ _________ ]

69:  Average (P71)
 1: 1         Reps
 2: 3         Loc [ _________ ]

70:  Average (P71)
 1: 1         Reps
 2: 4         Loc [ _________ ]

71:  Average (P71)
 1: 1         Reps
 2: 51        Loc [ _________ ]

72:  Maximum (P73)
 1: 1         Reps
 2: 10        Value with Hr-Min
 3: 51        Loc [ _________ ]

73:  Minimum (P74)
 1: 1         Reps
 2: 10        Value with Hr-Min
 3: 51        Loc [ _________ ]

74:  Average (P71)
 1: 1         Reps
 2: 52        Loc [ _________ ]

75:  Maximum (P73)
 1: 1         Reps
 2: 10        Value with Hr-Min
 3: 52        Loc [ _________ ]

76:  Minimum (P74)
 1: 1         Reps
 2: 10        Value with Hr-Min
 3: 52        Loc [ _________ ]

77:  If Flag/Port (P91)
 1: 13        Do if Flag 3 is High
 2: 30        Then Do

78:  If Flag/Port (P91)
 1: 14        Do if Flag 4 is High
 2: 0         Go to end of Program
Table

79:  If (X<=>F) (P89)
 1: 13        X Loc [ _________ ]
 2: 4         <
 3: 5         F
 4: 30        Then Do

80:  Beginning of Loop (P87)
 1: 1         Delay
 2: 1         Loop Count

81:  Pulse (P3)
 1: 1         Reps
 2: 1         Pulse Input Channel
 3: 2         Switch Closure, All
Counts
 4: 14        Loc [ _________ ]
 5: .1        Mult
 6: 0         Offset

82:  Z=X*F (P37)
 1: 14        X Loc [ _________ ]
 2: 1         F
 3: 14        Z Loc [ _________ ]

83:  End (P95)

84:  If (X<=>F) (P89)
 1: 14        X Loc [ _________ ]
 2: 4         <
 3: 5         F
 4: 30        Then Do

85:  Do (P86)
 1: 2         Call Subroutine 2

86:  Do (P86)
 1: 28        Set Flag 8 Low

87:  Initiate Telecommunications
(P97)
 1: 21        Phone Modem/1200 Baud
 2: 0         Never Disabled
 3: 60        Seconds Call Time Limit
 4: 0         Seconds Before Fast
Retry
 5: 0         Fast Retries
 6: 0         Minutes Before Slow
Retry
 7: 26        Failures Loc [ _________
]
 8: 1         Call-Back ID

88:  Extended Parameters (P63)
 1: 1         Option
 2: 8         Option
 3: 0         Option
 4: 0         Option
```

```
 5: 3         Option
 6: 9         Option
 7: 1         Option
 8: 3         Option

89:  Extended Parameters (P63)
 1: 0         Option
 2: 3         Option
 3: 6         Option
 4: 44        Option
 5: 44        Option
 6: 44        Option
 7: 44        Option
 8: 2         Option

90:  Extended Parameters (P63)
 1: 2         Option
 2: 2         Option
 3: 2         Option
 4: 2         Option
 5: 2         Option
 6: 2         Option
 7: 2         Option
 8: 13        Option

91:  End (P95)

92:  End (P95)

93:  End (P95)

94:  If (X<=>F) (P89)
 1: 4         X Loc [ __________ ]
 2: 4         <
 3: 35        F
 4: 30        Then Do

95:  Do (P86)
 1: 6         Call Subroutine 6

96:  End (P95)

97:  Read Ports (P25)
 1: 8         Mask (0..255)
 2: 27        Loc [ __________ ]

98:  Read Ports (P25)
 1: 16        Mask (0..255)
 2: 28        Loc [ __________ ]

99:  If Flag/Port (P91)
 1: 13        Do if Flag 3 is High
 2: 30        Then Do

100:  If Flag/Port (P91)
 1: 14        Do if Flag 4 is High
 2: 0         Go to end of Program
Table

101:  If (X<=>F) (P89)
 1: 27        X Loc [ __________ ]
 2: 3         >=
 3: 8         F
 4: 30        Then Do

102:  Do (P86)
 1: 4         Call Subroutine 4

103:  Do (P86)
 1: 28        Set Flag 8 Low

104:  Initiate Telecommunications
(P97)
 1: 21        Phone Modem/1200 Baud
 2: 0         Never Disabled
 3: 60        Seconds Call Time Limit
 4: 0         Seconds Before Fast
Retry
 5: 0         Fast Retries
 6: 0         Minutes Before Slow
Retry
 7: 0         Failures Loc [ __________
]
 8: 1         Call-Back ID

105:  Extended Parameters (P63)
 1: 1         Option
 2: 8         Option
 3: 0         Option
 4: 0         Option
 5: 3         Option
 6: 9         Option
 7: 1         Option
 8: 3         Option

106:  Extended Parameters (P63)
 1: 0         Option
 2: 3         Option
 3: 6         Option
 4: 44        Option
 5: 44        Option
 6: 44        Option
 7: 44        Option
 8: 4         Option

107:  Extended Parameters (P63)
 1: 4         Option
 2: 4         Option
 3: 4         Option
 4: 4         Option
 5: 4         Option
 6: 4         Option
 7: 4         Option
```

```
 8: 13        Option

108:  End (P95)

109:  End (P95)

110:  If Flag/Port (P91)
 1: 13        Do if Flag 3 is High
 2: 30        Then Do

111:  If (X<=>F) (P89)
 1: 28        X Loc [ _________ ]
 2: 3         >=
 3: 16        F
 4: 30        Then Do

112:  Do (P86)
 1: 5         Call Subroutine 5

113:  Do (P86)
 1: 28        Set Flag 8 Low

114:  If Flag/Port (P91)
 1: 28        Do if Flag 8 is Low
 2: 30        Then Do

115:  Beginning of Loop (P87)
 1: 2         Delay
 2: 0         Loop Count

116:  If (X<=>F) (P89)
 1: 29        X Loc [ _________ ]
 2: 3         >=
 3: 2         F
 4: 31        Exit Loop if True

117:  Do (P86)
 1: 28        Set Flag 8 Low

118:  Initiate Telecommunications
(P97)
 1: 21        Phone Modem/1200 Baud
 2: 8         Disabled when User Flag
8 is High
 3: 60        Seconds Call Time Limit
 4: 0         Seconds Before Fast
Retry
 5: 0         Fast Retries
 6: 0         Minutes Before Slow
Retry
 7: 26        Failures Loc [ _________
]
 8: 1         Call-Back ID

119:  Extended Parameters (P63)
 1: 1         Option
 2: 8         Option
 3: 0         Option
 4: 0         Option
 5: 3         Option
 6: 9         Option
 7: 1         Option
 8: 3         Option

120:  Extended Parameters (P63)
 1: 0         Option
 2: 3         Option
 3: 6         Option
 4: 44        Option
 5: 44        Option
 6: 44        Option
 7: 44        Option
 8: 6         Option

121:  Extended Parameters (P63)
 1: 6         Option
 2: 6         Option
 3: 6         Option
 4: 6         Option
 5: 6         Option
 6: 6         Option
 7: 6         Option
 8: 13        Option

122:  Do (P86)
 1: 18        Set Flag 8 High

123:  Z=Z+1 (P32)
 1: 29        Z Loc [ _________ ]

124:  End (P95)

125:  End (P95)

126:  End (P95)

127:  End (P95)

128:  If (X<=>F) (P89)
 1: 2         X Loc [ _________ ]
 2: 3         >=
 3: 15        F
 4: 30        Then Do

129:  If (X<=>F) (P89)
 1: 8         X Loc [ _________ ]
 2: 4         <
 3: 25        F
 4: 30        Then Do

130:  Z=F (P30)
 1: 5000      F
 2: 0         Exponent of 10
 3: 50        Z Loc [ _________ ]
```

```
131:  SDM-AO4 (P103)
 1: 1          Reps
 2: 0          SDM Address
 3: 50         Loc [ _________ ]

132:  End (P95)

133:  If (X<=>F) (P89)
 1: 8          X Loc [ _________ ]
 2: 3          >=
 3: 25         F
 4: 30         Then Do

134:  If (X<=>F) (P89)
 1: 8          X Loc [ _________ ]
 2: 4          <
 3: 75         F
 4: 9          Call Subroutine 9

135:  End (P95)

136:  End (P95)

137:  CASE (P93)
 1: 7          Case Loc [ _________ ]

138:  If Case Location < F (P83)
 1: 15         F
 2: 30         Then Do

139:  Z=X*F (P37)
 1: 7          X Loc [ _________ ]
 2: 167        F
 3: 50         Z Loc [ _________ ]

140:  SDM-AO4 (P103)
 1: 1          Reps
 2: 0          SDM Address
 3: 50         Loc [ _________ ]

141:  End (P95)

142:  End (P95)

143:  If Flag/Port (P91)
 1: 12         Do if Flag 2 is High
 2: 30         Then Do

144:  If Flag/Port (P91)
 1: 11         Do if Flag 1 is High
 2: 3          Call Subroutine 3

145:  End (P95)

146:  If Flag/Port (P91)
 1: 11         Do if Flag 1 is High
 2: 30         Then Do

147:  If Flag/Port (P91)
 1: 12         Do if Flag 2 is High
 2: 7          Call Subroutine 7

148:  End (P95)

149:  Do (P86)
 1: 15         Set Flag 5 High

*Table 2 Program
  01: 0.0000    Execution Interval
(seconds)

1:  Full Bridge (P6)
 1: 1          Reps
 2: 23         25 mV 60 Hz Rejection
Range
 3: 4          DIFF Channel
 4: 3          Excite all reps w/Exchan
3
 5: 2500       mV Excitation
 6: 30         Loc [ _________ ]
 7: 23.155     Mult
 8: -84.541    Offset

2:  Volt (Diff) (P2)
 1: 1          Reps
 2: 25         2500 mV 60 Hz Rejection
Range
 3: 5          DIFF Channel
 4: 53         Loc [ _________ ]
 5: 2.6        Mult
 6: 0          Offset

3:  Volt (Diff) (P2)
 1: 1          Reps
 2: 25         2500 mV 60 Hz Rejection
Range
 3: 1          DIFF Channel
 4: 51         Loc [ _________ ]
 5: .64        Mult
 6: 1.6        Offset

4:  Volt (Diff) (P2)
 1: 1          Reps
 2: 25         2500 mV 60 Hz Rejection
Range
 3: 3          DIFF Channel
 4: 52         Loc [ _________ ]
 5: .65        Mult
 6: -.8        Offset

*Table 3 Subroutines

1:  Beginning of Subroutine (P85)
```

```
 1: 1         Subroutine 1

2:  Z=F (P30)
 1: 0         F
 2: 1         Exponent of 10
 3: 18        Z Loc [ _________ ]

3:  Time (P18)
 1: 1         Minutes into current day
(maximum 1440)
 2: 0         Mod/By
 3: 15        Loc [ _________ ]

4:  Set Active Storage Area (P80)
 1: 3         Input Storage Area
 2: 23        Loc [ _________ ]

5:  Do (P86)
 1: 10        Set Output Flag High

6:  Real Time (P77)
 1: 100       Day (midnight = 0000)

7:  Do (P86)
 1: 20        Set Output Flag Low

8:  Set Active Storage Area (P80)
 1: 1         Final Storage Area 1
 2: 1         Array ID

9:  Z=F (P30)
 1: 1440      F
 2: 0         Exponent of 10
 3: 16        Z Loc [ _________ ]

10:  Z=X/Y (P38)
 1: 15        X Loc [ _________ ]
 2: 16        Y Loc [ _________ ]
 3: 17        Z Loc [ _________ ]

11:  Z=X+Y (P33)
 1: 23        X Loc [ _________ ]
 2: 17        Y Loc [ _________ ]
 3: 25        Z Loc [ _________ ]

12:  Z=X-Y (P35)
 1: 25        X Loc [ _________ ]
 2: 18        Y Loc [ _________ ]
 3: 1         Z Loc [ _________ ]

13:  End (P95)

14:  Beginning of Subroutine (P85)
 1: 2         Subroutine 2

15:  Do (P86)
 1: 78        Pulse Port 8

16:  Do (P86)
 1: 10        Set Output Flag High

17:  Set Active Storage Area (P80)
 1: 2         Final Storage Area 2
 2: 0         Array ID

18:  Real Time (P77)
 1: 1120      (Same as 1220) Y,D,Hr/Mn

19:  Sample (P70)
 1: 1         Reps
 2: 12        Loc [ _________ ]

20:  Do (P86)
 1: 14        Set Flag 4 High

21:  End (P95)

22:  Beginning of Subroutine (P85)
 1: 3         Subroutine 3

23:  Do (P86)
 1: 78        Pulse Port 8

24:  Do (P86)
 1: 22        Set Flag 2 Low

25:  End (P95)

26:  Beginning of Subroutine (P85)
 1: 4         Subroutine 4

27:  Do (P86)
 1: 78        Pulse Port 8

28:  Do (P86)
 1: 10        Set Output Flag High

29:  Set Active Storage Area (P80)
 1: 2         Final Storage Area 2
 2: 0         Array ID

30:  Real Time (P77)
 1: 1120      (Same as 1220) Y,D,Hr/Mn

31:  Sample (P70)
 1: 1         Reps
 2: 27        Loc [ _________ ]

32:  Do (P86)
 1: 14        Set Flag 4 High

33:  End (P95)

34:  Beginning of Subroutine (P85)
```

```
 1: 5         Subroutine 5

35:  Do (P86)
 1: 10        Set Output Flag High

36:  Set Active Storage Area (P80)
 1: 2         Final Storage Area 2
 2: 0         Array ID

37:  Real Time (P77)
 1: 1120      (Same as 1220) Y,D,Hr/Mn

38:  Sample (P70)
 1: 1         Reps
 2: 28        Loc [ _________ ]

39:  Do (P86)
 1: 16        Set Flag 6 High

40:  End (P95)

41:  Beginning of Subroutine (P85)
 1: 6         Subroutine 6

42:  Do (P86)
 1: 77        Pulse Port 7

43:  Do (P86)
 1: 10        Set Output Flag High

44:  Set Active Storage Area (P80)
 1: 2         Final Storage Area 2
 2: 0         Array ID

45:  Real Time (P77)
 1: 1120      (Same as 1220) Y,D,Hr/Mn

46:  Sample (P70)
 1: 1         Reps
 2: 4         Loc [ _________ ]

47:  Do (P86)
 1: 17        Set Flag 7 High

48:  End (P95)

49:  Beginning of Subroutine (P85)
 1: 7         Subroutine 7

50:  Do (P86)
 1: 78        Pulse Port 8

51:  Do (P86)
 1: 21        Set Flag 1 Low

52:  End (P95)

53:  Beginning of Subroutine (P85)
 1: 9         Subroutine 9

54:  Z=1/X (P42)
 1: 8         X Loc [ _________ ]
 2: 8         Z Loc [ _________ ]

55:  Z=F (P30)
 1: 125       F
 2: 3         Exponent of 10
 3: 10        Z Loc [ _________ ]

56:  Z=X*Y (P36)
 1: 8         X Loc [ _________ ]
 2: 10        Y Loc [ _________ ]
 3: 50        Z Loc [ _________ ]

57:  SDM-AO4 (P103)
 1: 1         Reps
 2: 0         SDM Address
 3: 50        Loc [ _________ ]

58:  End (P95)

59:  Beginning of Subroutine (P85)
 1: 8         Subroutine 8

60:  Z=F (P30)
 1: 1         F
 2: 0         Exponent of 10
 3: 35        Z Loc [ _________ ]

61:  Do (P86)
 1: 10        Set Output Flag High

62:  Set Active Storage Area (P80)
 1: 2         Final Storage Area 2
 2: 0         Array ID

63:  Real Time (P77)
 1: 1120      (Same as 1220) Y,D,Hr/Mn

64:  Sample (P70)
 1: 1         Reps
 2: 35        Loc [ _________ ]

65:  Sample (P70)
 1: 1         Reps
 2: 34        Loc [ _________ ]

66:  End (P95)

End Program

-Input Locations-
1 _________ 1 1 1
2 _________ 1 8 1
```

3 __________ 1 3 1
4 __________ 1 3 1
5 __________ 1 5 1
6 __________ 0 0 0
7 __________ 1 2 1
8 __________ 1 5 2
9 __________ 0 0 0
10 __________ 1 1 1
11 __________ 0 0 0
12 __________ 1 4 1
13 __________ 1 7 1
14 __________ 1 2 2
15 __________ 1 1 1
16 __________ 1 1 1
17 __________ 1 1 1
18 __________ 1 1 1
19 __________ 0 0 0
20 __________ 0 0 0
21 __________ 0 0 0
22 __________ 0 0 0
23 __________ 1 1 1
24 __________ 0 0 0
25 __________ 1 1 1
26 __________ 1 0 3
27 __________ 1 2 1
28 __________ 1 2 1
29 __________ 1 1 2
31 __________ 1 1 1
32 __________ 1 2 2
51 __________ 1 5 2
52 __________ 1 5 2
53 __________ 1 2 2
50 __________ 1 4 3
33 __________ 1 1 1
34 __________ 1 2 1
35 __________ 1 2 1
30 __________ 1 0 1
-Program Security-
0
0
0
-Mode 4-
-Final Storage Area 2-
6200

Appendix C

Field Operation Forms

System Operation Log
Quarterly Sensor Calibration Log
Annual System Inspection Check List
Annual Planned Maintenance Check List
Alarm Response Log

Operation Log

UniFirst Ground Water Treatment System
Woburn, Massachusetts

Date ______________
Time ______________
Operator ______________

Purpose: ○ Routine ○ Maintenance
○ Sampling ○ Carbon Change

Comments: ____

CR-10 Keypad Display Data	Key	Reading	Units	Flags (* 6 A D)
Time	* 5	______		1 ○
UC22 Water Elevation	* 6 2 A	______	ft	2 ○
Carbon Pressure Influent	* 6 5 A	______	psi	3 ○
Carbon Pressure Pri/Sec	* 6 51 A	______	psi	4 ○
Carbon Pressure Sec/Tert	* 6 52 A	______	psi	5 ○
Flow Rate	* 6 13 A	______	gpm	6 ○
Annunciator #1 Status	* 6 27 A	______		7 ○
Annunciator #2 Status	* 6 28 A	______		8 ○
Tank Pressure MMF	* 6 53 A	______	psi	
Signal to Auto-Control Valve B1	* 6 50 A	______	mV	

Influent Stream/Multi-Media Filter

Inlet Pressure upstream of Valve B3: ________ psig

Pressure at MM Filter:

Inlet: ________ psig Backwash Initiated: ○ Yes ○ No
Outlet: ________ psig *(if YES, fill out Pump P4 Section)*
Δ= ________ psig

Tanks

Discharge Tank Level: ________ ft above floor
Backwash Tank Level: ________ ft above floor

Pressure Reduction Valve

Pressure at R2: Upstream ________ psig
Downstream ________ psig

Carbon Tanks

Process Order: ○ 1-2-3 ○ 2-3-4 ○ 3-4-1 ○ 4-1-2

Pressure:

Primary In: ________ psig	Secondary In: ________ psig	Tertiary In: ________ psig
Secondary In: ________ psig	Tertiary In: ________ psig	Tertiary Out: ________ psig
Δ= ________ psig	Δ= ________ psig	Δ= ________ psig

Backwash Initiated: ○ Yes ○ No
(if YES, fill out Pump P4 Section)

Backwash Pump P4

Operation: ○ MM Filter ○ Carbon 1 ○ Carbon 2 ○ Carbon 3 ○ Carbon 4

Start: Time ____:____ Level ________ ft above floor Pressure at Pump Discharge ________ psig

Stop: Time ____:____ Level ________ ft above floor

Duration: ________ min ________ change x 330.5 gal/ft = ________ gallons

Final Readings after backwash:

Inlet: ________ psig

Outlet: ________ psig

Δ= ________ psig

Re-Inject Pump P5

Start Time ____:____

Cartridge Filter Pressure: Upstream ________ psig

Downstream ________ psig

Δ= ________ psig

Pressure at Injection Point: ________ psig

Filter Cartridge: ○ Replaced

Hazardous Waste Storage Area

○ Yes ○ No Are the containers closed?

○ Yes ○ No Are the containers properly labeled?

○ Yes ○ No Are the containers in good condition?

○ Yes ○ No Is the floor clean?

○ Yes ○ No Are the aisles clear?

Describe any Corrections ____

____

____

Date of Corrections ________________

Comments

____

____

____

____

____

____

____

____

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Revised June 2006

Quarterly Sensor Calibration

UniFirst Ground Water Treatment System
Woburn, Massachusetts

Date ________________
Time ________________
Operator ________________

I. Synchronize a watch with the data logger time (*5).

II. Flow Sensor Calibration Check

The flow sensor is to be compared to the mechanical meter, M1.

1.) Divert flow through M1.
   a.) Open valves B6 and B7.
   b.) Close valve B13.
2.) Record flow rate.
   a.) Using a watch and the sweep hand of the meter, record the number of gallons in one minute and the time at the end of the reading in 4.b.i.
3.) Reset valves for normal operation.
   a.) Open valve B13.
   b.) Close valves B6 and B7.
4.) Retrieve data and check accuracy.
   a.) Review the data logger values for the time the manual flow measurement was taken (see O&M Manual, Appendix C, Section B 3.5) and record the value in 4.b.ii.
   b.) Compare the flow rates.

i. M1 Flow Rate ____________ gpm   Time ____________

ii. Data Logger Value ____________ gpm

$$Accuracy = \frac{\text{M1 Flow - DataLogger Flow}}{\text{M1 Flow}} * 100 \qquad \frac{\_\_\_\_\_\_ - \_\_\_\_\_\_}{\_\_\_\_\_\_} *100 = \_\_\_\_$$

If the accuracy is greater than 2%, run calibration procedure again.
If the accuracy continues to exceed 2%, consult with the Design Engineer.

III. UC22 Pressure Transducer Calibration Check

The water level in the extraction well (UC22) as measured by the pressure transducer is compared to a manual water level measurement.

1.) Measure the water level in UC22.
   a.) Unlock the monitoring tube port at the UC22 well head.
   b.) Using a water level tape, measure the depth to water from the v-notch in the top of the casing. Record the measurement and time in 2.b.i.
   c.) Decontaminate the water level probe and lock the well head.
2.) Retrieve data and check accuracy.
   a.) Review the data logger values for the time the water level measurement was taken (see O&M Manual, Appendix C, Section B 3.5) and record the value in 2.b.ii.
   b.) Calculate water level elevation by subtracting the depth to water from the well head elevation.

Well Head Elevation	85.53	feet	
i. Depth to Water	________	feet	Time ____________
Manual Water Elevation	________	feet	(subtract depth from elevation)
ii. Data Logger Elevation	________	feet	

$$Accuracy = \frac{\text{Manual Elev - DataLogger Elev}}{\text{Manual Elev}} * 100 \qquad \frac{\_\_\_\_\_\_ - \_\_\_\_\_\_}{\_\_\_\_\_\_} *100 = \_\_\_\_$$

If the accuracy is greater than 2%, run calibration procedure again.
If the accuracy continues to exceed 2%, consult with the Design Engineer.

IV. Well Head Junction Box Desiccant

a.) View the desiccant, "DRI-CAN", indicator through the window in the junction box.
b.) If the indicator is pink, the DRI-CAN has reached saturation and must be replaced.

V. Pressure Transducer at Carbon Tank Calibration Check

The pressure indicated on the gauge upstream of the first carbon unit is compared to the pressure recorded by the data logger.

1.) Read carbon pressure.
   a.) Record the pressure indicated on the transducer pressure gauge and the time in 2.b.i.
2.) Retrieve data and check accuracy.
   a.) Review the data logger values for the time the carbon pressure reading was taken (see O&M Manual, Appendix C, Section B 3.5) and record the value in 2.b.ii.
   b.) Calculate accuracy.

      i. Transducer Pressure ________ psi Time ___________
      ii. Data Logger Pressure ________ psi

$$Accuracy = \frac{\text{Trans. Press - DataLogger Press}}{\text{Trans Press}} * 100 \qquad \frac{\_\_\_\_\_\_ - \_\_\_\_\_\_}{} * 100 = \_\_\_\_$$

If the accuracy is greater than 2%, run calibration procedure again.
If the accuracy continues to exceed 2%, consult with the Design Engineer.

VI. Test Pump (P1) Control Circuit

The control circuit is tested by simulating a high water condition in the floor sump.

1.) Immerse the electrodes for the floor sump in a container of water and record the responses:
   a.) Power dropped to Pump P1: o Yes o No
   b.) Annunciator #2 energized: o Yes o No
   c.) Call-out routine initiated: o Yes o No

If any of these responses do not occur, consult with the Design Engineer.

Annual Inspection Report

UniFirst Ground Water Treatment System
Woburn, Massachusetts

Date ______________
Operator ______________

I. UC22 Well Head

Remove any debris around the well head.

Condition of well cap ______________

Signs of wear or abuse O Yes O No Describe ______________

Condition of pressure transducer junction box ______________

Condition of desiccant (replace if pink) ______________

II. Influent Pipe Corridor

Evidence of settlement O Yes O No

Evidence of leakage O Yes O No

III. Discharge Pipe Corridor

Evidence of settlement O Yes O No

Evidence of leakage O Yes O No

Open and inspect the two cleanouts located at 90° bends on the discharge line.

Remove valve box cover and 4" threaded plug.

Condition of 1st cleanout (outside treatment room) ______________

Condition of 2nd cleanout (@NW corner of site) ______________

IV. Discharge Outfall at the Aberjona River

Describe conditions ______________

V. Treatment System Piping and Valving

Inspect all piping, fittings and valving for leakage and signs of rust. With the treatment system off, exercise all valves through their complete range of operation and restore to their original position. Complete the following table to assure that every valve is exercised. Indicate the sequence of operation: Found Open - Closed - Left Open (OCO) or Found Closed - Opened - Left Closed (COC). Inspect and indicate the condition of each valve tag, replace as needed and so note on the table.

Valve Inspection & Exercise Record

Valve	Exercise Sequence	ID Tag Condition	Valve	Exercise Sequence	ID Tag Condition
B1			B7		
B2			B10		
B3			B11		
B4			B12		
B5			B13		
B6			B14		

Valve Inspection & Exercise Record

Valve	Exercise Sequence	ID Tag Condition	Valve	Exercise Sequence	ID Tag Condition
B15			B24		
B16			B25		
B31			B26		
B32			B27		
B33			B27A		
B34			B28		
B35			B29		
B36			B30		
B37			G-1		
B38			G-2		
B39			G-3		
B106			G-6		
B17			G-7		
B19			F1		
B20			F2		
B21			F3		
B22			F4		
B23			F5		

VI. Treatment System Tankage

Visually inspect the tankage associated with the treatment system. This includes: the multi-media filter; the carbon tanks; the backwash settling tank; and the discharge tank; Inspect the tanks for general condition, at every weld or seam and at each pipe connection.

Multi-Media Filter

General Condition ______________________________

Condition of Welds ______________________________

Condition at pipe penetrations ______________________________

Cartridge Filter

General Condition ______________________________

Condition of Welds ______________________________

Carbon Tanks

General Condition ______________________________

Condition at pipe penetrations ______________________________

Backwash Settling Tank

General Condition ______________________________

Condition at pipe penetrations ______________________________

Discharge Tank

General Condition ______________________________

Condition at pipe penetrations ______________________________

VII. Backwash Multi-media Filter

Backwash the multi-media filter following the procedure in Section 3.4.1 of the O&M Manual. Backwash to be performed during the Annual Inspection, unless previously accomplished during the year of operation.

Backwash Performed: ______________ Duration (minutes): ______________

VIII. Cartridge Filter

Open cartridge and remove filter element.
Clean the filter element per the manufacturer's recommendations.
Collect the rinsate in a drum designated for this purposed.

IX. Floor Sump Pump (P7)

Inspect and test the floor sump.

General Condition ______________________________

Pump Operation ______________________________

Clean suction screen on bottom of pump.

X. Hydrogen Peroxide Containment Structure

Inspect the containment structure and lining. Remove any debris that may have accumulated.

General Condition ______________________________

Liner Condition ______________________________

XI. Floor to Wall Seal and Containment Curbs

Inspect the condition of the floor to wall seal along the south and west walls of the treatment room. Check the seal for tears, abrasions and continuity with the walls and floor. Inspect the containment curbing at the doors to the treatment room and those adjacent to the discharge tank. Check to assure the curbing is bonded to the concrete slab.

Floor to Wall Seal general condition ______________________________

Containment curbs general condition ______________________________

XII. Emergency Eyewash/Shower

Test and inspect the emergency eyewash and shower.

Eyewash - tested o Yes o No General condition ______________________________

Shower - tested o Yes o No General condition ______________________________

XIII. Pressure Relief Valve and Flow Switch

Test and inspect the pressure relief valve (system must be operating) and the flow switch.

Test pressure relief valve and note response:

Well Pump (P1) shut down? O Yes O No

Annunciator #2 Lit? O Yes O No

Dial Out Routine Activated? O Yes O No

Relief value and flow switch general condition ______________________________

XIV. High Level Electrodes - Backwash Tank & Floor Sump

Test and inspect the high level electrode assemblies for the backwash settling tank and floor sump.
Disconnect the modem telephone line to avoid alarm callouts.
Simulate a high level condition by immersing the sensors in a container of water. Test the level sensors with the well pump operating and note the responses.

Backwash Settling Tank

Test high level electrodes and note response:

Well Pump (P1) shut down? O Yes O No

Annunciator #1 Lit? O Yes O No

General condition of the electrode assembly ______________________________

Floor Sump

Test high level electrodes and note response:

Well Pump (P1) shut down? O Yes O No

Annunciator #2 Lit? O Yes O No

General condition of the electrode assembly ______________________________

Remember to reconnect the modem telephone line.

XV. Ventilation System

Test the operation of and inspect the vent fan and make-up louvers.

Vent Fan

Test Operation __________ General Condition ______________________________

Make-up Air Louvers

Test Operation __________ General Condition ______________________________

XVI. Data Logger

Open the datalogger enclosure and replace the desiccant.

XVII. Recommendations

Record below any recommendations to the treatment system operation or maintenance.

Annual Maintenance Check List

UniFirst Ground Water Treatment System
Woburn, Massachusetts

I. Diaphragm Check Valve

Manufactured by CLA-VAL CO., Model 81-01, 2" angle style

Inspect the diaphragm, disc and seat o-ring carefully for signs of wear, corrosion or other abnormal condition (refer to manufacturer's literature). Replace these parts unless the inspection indicates they are free of wear or other abnormal condition.

		Parts Replaced				
Date Inspected	____________	Diaphragm	O	Yes	O	No
Inspector	______________________	Disc	O	Yes	O	No
Mass. Plumber's License No:	____________	Seat O-ring	O	Yes	O	No

II. Pressure Reducing Valve

Manufactured by WATTS REGULATOR, Model 223LP, 1½"

Inspect the diaphragm, seat, disc and gaskets carefully for signs of wear, corrosion or other abnormal condition (refer to manufacturer's literature). Replace these parts unless the inspection indicates they are free of wear or other abnormal condition.

		Parts Replaced				
Date Inspected	____________	Diaphragm	O	Yes	O	No
Inspector	______________________	Disc	O	Yes	O	No
Mass. Plumber's License No:	____________	Seat	O	Yes	O	No
		Seat Gasket	O	Yes	O	No
		Bottom Plug Gasket	O	Yes	O	No
		Disc Screw	O	Yes	O	No

If additional maintenance activities are performed, list them on a separate page and include the following information:

Date, component, description of problem, description of maintenance performed and remedial recommendations (if appropriate).

Alarm Response Log

UniFirst Ground Water Treatment System
Woburn, Massachusetts
Complete this form whenever an alarm condition shuts down the system

Response Date: ______________ Alarm Date: ______________

Response Time: ______________ Alarm Time: ______________

Responding Operator: ______________ Pager Codes Received: ______________

CR-10 Keypad Display Data	Key	Reading	Flags (* 6 A D)
Time	* 5	________	1 O
Annunciator #1 Status	* 6 27 A	________	2 O
Annunciator #2 Status	* 6 28 A	________	3 O
			4 O
Audible Alarm	O Yes	O No	5 O
			6 O
Annunciator #1 Indicator Lamps			7 O
Backwash	O On	O Off	8 O
Annunciator #2 Indicator Lamps			
Well Pump	O On	O Off	
Low Room Temp	O On	O Off	

Cause of Alarm ____

____

____

____

Repairs/Services Undertaken ____

____

____

____

System Restarted

Date: ______________

Time: ______________

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Appendix D

Valve & Equipment Schedules
Valve Startup Positions

Equipment Schedule

Components

Unit	Manufacturer	Model #	Design Flow (gpm)	Max Pressure (psi)	Maximum Delta Pressure (psi)
Multi-Media Filter	Bruner	MS-30-2-G	50 to 75	100	18
Carbon Tank (4)	Structural	31647	50	150	15
Cartidge Filter	Harmsco	HUR-90-HP	2 to 7	150	15

Pressure Relief Valve

Size	Manufacturer	Model #	Location & Set Pressure
3/4"	ITT Grinnel	M3- H174A	Upstream of auto-control valve 100 psi set pressure

Automatic Control Valve

Size	Manufacturer	Model #	Location	Purpose
2"	George Fischer	EA20 Elec Actuator, PE22 Positioner	Process piping upstream of flow sensor	Receives voltage signal from datalogger to control flowrate to maintain pumping elevation in UC22

Diaphragm Check Valve

Size	Manufacturer	Model #	Location	Range (gpm)	Purpose
2"	CLA VAL	81-01-2"	At system inlet	0 to 60	Reduce water hammer from Pump P1 startup

Pressure Regulator

Size	Manufacturer	Model #	Location	Range (psi)	Purpose
1.5"	Watts	223LP	After MMF and before carbon	10 to 80	pressure reduction

Pump Schedule

Pump	Manufacturer	Model #	HP	Volt	Phase	Function	Operating Points	Shut-Off Head
P1	Grundfos	*40S30-9*	3	*208*	3	*Well pump discharge to system*	*185 ft TDH @ 55 gpm*	250
P4	Burks Pumps	330GA6-1½	3	208	3	Provides backwash to MMF and carbon tanks	99 ft TDH @ 75 gpm for MMF backwash 103 ft TDH at 50 gpm for carbon backwash	108 ft
P5	Burks Pumps	34CS6M	1/3	208	1	Pumps settled backwash back into system	120 ft TDH @4.5 gpm	200 ft
P7	Zoeller	M267F	1/2	115	1	Sump Pump	15 ft TDH @50 gpm	21.5 ft
P8	WaterAce	R6S	1/6	115	1	Spare utility pump		

Meter Schedule

Rotameter

Location	Manufacturer	Model	Size	Range	Purpose
Riser from Pump P4 to carbon backwash	Omega	FL-75M	2"	20 to 100 gpm	Measure backwash flowrate to carbon tanks

Flow Sensor & Monitor

Location	Manufacturer	Model #	Range	Signal	Purpose
Flow sensor in process piping downstream of auto control valve	Data Industrial	228-B	1 to 30 ft/sec	Proportional (frequency)	Provides input to flow monitor
Flow monitor in front of data logger panel	Data Industrial	1000	0.5 to 40 inch pipe diameter calibration range	Pulse (frequency)	Displays flow rate and total flow Provides input to data logger

Water Meter

Designation	Manufacturer	Model #	Size	Location	Purpose
M1	Neptune	T-10	2"	Side loop before carbon units	Compare flowrate from sensors

Sensor Schedule

Pressure Transducers

Location	Manufacturer	Model #	Rating (psi)	Signal	Purpose
In pumping well UC-22	Druck	PDCR 940	100	Proportional (mV)	Monitor drawdown & provide input data to auto valve
Upstream of Carbon Tanks	Omega	PX-800-050GV	50	Proportional (mV)	Monitor carbon tank pressure
Between Primary & Secondary Carbon	Omega	PX612-030GV	30	Proportional (mV)	Monitor carbon tank pressure
Between Secondary & Tertiary Carbon	Omega	PX612-030GV	30	Proportional (mV)	Monitor carbon tank pressure
Upstream of MMF	Omega	PX612-100GV	100	Proportional (mV)	Monitor MMF influent pressure

Level Electrodes

Location	Manufacturer	Model #	Number	Configuration	Purpose
In floor sump	B/W Controls	6013-SS-X-A, Solid Rod	2	N.O.	Shuts down system if high level in sump
In backwash settling tank	B/W Controls	6013-W10-15, Wire Suspension	3	N.O.	Shuts down system if high level in tank
				N.C.	Shuts down Pump P5 2.0 ft above suction level

Differential Pressure Switch

Location	Manufacturer	Model #	Range	Rating	Purpose
At cartridge filter	Dwyer Instruments	H3A-3	5 to 70 psid	1500 psi	Shuts down Pump P5 when pressure differential exceeds 15 psi

Flow Switch

Location	Manufacturer	Model #	Configuration	Rating	Purpose
At pressure relief valve	Watts	PS20	N.O.	150 psi	Shuts down system if flow sensed in pressure relief line

Valve Schedule

Designation	Size	Normal Position	Location	Purpose
Ball Valves				
B1	2"	Varies	Influent piping	Auto regulates flow to maintain drawdown
B2	2"	N.O.	Upstream of MM filter	Close to bypass MMF
B3	2"	N.O.	At inlet piping	Isolates diaphragm check valve with B5
B4	2"	N.O.	At MMF discharge	Closed during backwash
B5	2"	N.O.	At inlet piping	Isolates diaphragm check valve with B3
B6	2"	N.C.	Upstream of meter M1	Open to check flow rate
B7	2"	N.C.	Downstream of meter M1	Open to check flow rate
B10	2"	N.C.	No function	
B11	2"	N.C.	On Pump P4 discharge	Open for pump to discharge
B12	2"	N.C.	At inlet piping	Open to bypass diaphragm check valve
B13	2"	N.O.	On discharge line	Bypass meter M1 loop
B14	2"	N.O.	On final discharge line	Isolate discharge tank
B15	2"	N.O.	At discharge tank	Isolate discharge tank
B16	2"	N.O.	On discharge line	Closed during backwash
B17	2"	N.C.	On Pump P4 suction	Isolate pump - open during backwash
B19	1"	N.C.	Suction on Pump P5	Isolate sediment strainer
B20	2"	N.C.	On Pump P4 discharge	Open to backwash filter
B21	2"	N.O.	Carbon Tank Influent	Open during regular operations
B22	1"	N.C.	On Pump P5 discharge	Isolate pump/cartridge filter
B23	2"	N.C.	Carbon backwash influent line	Open for backwash
B24	2"	N.C.	Carbon backwash effluent line	Open for backwash
B25	2"	N.C.	On Pump P4 discharge	Open to backwash carbon
B26	2"	N.O.	Carbon Tank Effluent	Open during regular operations
B27 & B27A	1"	N.C.	Downstream of cartridge filter	Isolate cartridge filter
B28	2"	Varies	Carbon Tank #1	Influent to tank
B29	2"	Varies	Carbon Tank #2	Influent to tank
B30	2"	Varies	Carbon Tank #3	Influent to tank
B31	2"	Varies	Carbon Tank #4	Influent to tank
B32	1/2"	N.C.	Top of Carbon #1	Air Vent
B33	1/2"	N.C.	Top of Carbon #2	Air Vent
B34	1/2"	N.C.	Top of Carbon #3	Air Vent
B35	1/2"	N.C.	Top of Carbon #4	Air Vent
B36	2"	Varies	Carbon Tank #1	Effluent from tank/Drain
B37	2"	Varies	Carbon Tank #2	Effluent from tank/Drain
B38	2"	Varies	Carbon Tank #3	Effluent from tank/Drain
B39	2"	Varies	Carbon Tank #4	Effluent from tank/Drain
B106	2"	N.C.	Alt. suction at discharge	For portable pump

Valve Schedule

Designation	Size	Normal Position	Location	Purpose
Globe Valves				
F3	2"	N.C.	MMF	Effluent from MMF - open during backwash
G-1	2"	N.O.	Upstream of MMF	Regulate flow rate
G-2	2"	N.C.	Parallel installation with G-1	Regulate flow rate when MMF bypassed
G-3	2"	N.C.	Discharge of Pump P4	Regulate carbon tank backwash influent
G-6	1"	N.O.	At backwash reinjection	Regulate flow from Pump P5 during reinjection
G-7	2"	N.O.	Upstream of carbon units	Additional flow regulation
Gate Valves				
F1	2"	N.O.	MMF	Influent to MMF - closed during backwash
F2	2"	N.O.	MMF	Effluent from MMF, Influent from backwash pump P4
F4	1"	N.C.	MMF	Filter drain
F5	3/4"	N.C.	Cartridge filter	Filter drain

Initial Startup Valve Positions

Valve	Open	Closed
Ball Valves		
B1	✓	
B2	✓	
B3	✓	
B4	✓	
B5	✓	
B6		✓
B7		✓
B10		✓
B11		✓
B12		✓
B13	✓	
B14	✓	
B15	✓	
B16	✓	
B17		✓
B19		✓
B20		✓
B21	✓	
B22		✓
B23		✓
B24		✓
B25		✓
B26	✓	
B27		✓
B27A		✓
B28	Varies	
B29	Varies	
B30	Varies	
B31	Varies	
B32		✓
B33		✓
B34		✓
B35		✓
B36	Varies	
B37	Varies	
B38	Varies	
B39	Varies	
B106		✓

Valve	Open	Closed
Globe Valves		
G1	✓	
G2		✓
F3		✓
G3		✓
G6	✓	
G7	✓	
Gate Valves		
F1	✓	
F2	✓	
F4		✓
F5		✓

Appendix E

Equipment Manufacturer's Information

Setup as separate volumes:

Volume I	General Components
Volume II	Data Logger